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# Proceedings of The Second Pan American Scientific Congress

WASHINGTON, U. S. A.

Monday, December 27, 1915
to Saturday, January 8, 1916

Compiled and edited under the direction of
Glen Levin Swiggett, Assistant Secretary General

## SECTION III

## CONSERVATION OF NATURAL RESOURCES

GEORGE M. ROMMEL, CHIEF ANIMAL HUSBANDRY DIVISION, BUREAU OF ANIMAL INDUSTRY, U. S. DEPARTMENT OF AGRICULTURE, CHAIRMAN

## VOL. III

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# CONTENTS.


| | Page. |
|---|---|
| Letters of transmittal | VII |
| Register of writers of papers | XIII |
| Foreword | XV |
| Executive committee | 3 |
| Organization officers | 3 |
| Committees of Section III | 4 |
| Aims and purposes of the congress | 6 |
| Program statement of Section III | 6 |
| Adopted resolutions and recommendations of Section III | 7 |
| **Morning session of December 28, 1915** | 10 |
| Conservation and economic theory, by Richard T. Ely | 10 |
| The economic bearing of future trading in agricultural commodities, by Henry C. Emery | 21 |
| Conservation in its relation to industrial evolution, by Ralph Henry Hess | 26 |
| **Afternoon session of December 28, 1915** | 38 |
| A forest policy for a nation, by Henry S. Graves | 38 |
| The people's interest in water-power resources, by George Otis Smith | 45 |
| Relation of the Government to the marketing problem, by Beverly T. Galloway | 50 |
| **Joint session of Sections III, V, and VII** | 56 |
| The conservation of human energy, by T. N. Carver | 56 |
| **Joint session of subsection 1 of Section III and subsection 1 of Section VII** | 79 |
| **Joint session of subsection 3 of Section III and subsections 3 and 4 of Section V** | 80 |
| **Morning session of December 29, 1915** | 81 |
| Irrigation in the United States, by Samuel Fortier | 81 |
| The water requirement of plants as influenced by environment, by Lyman J. Briggs and H. L. Shantz | 95 |
| Relation between quantity of irrigation water used and quantity of crop produced, by John A. Widtsoe | 107 |
| Adaptation of methods of applying water to soils, by S. T. Harding | 121 |
| **Joint session of subsection 3 of Section III and subsection 3 of Section V** | 131 |
| Memoire sur la houille blanche au Brésil et ses applications, by Luiz Betim Paes Leme | 131 |
| Hydroelectric utilization at Niagara and elsewhere, by Maurice Deutsch | 142 |
| **Afternoon session of subsection 4, December 29, 1917** | 162 |
| Irrigation districts in the United States, by Frank Adams | 162 |
| Uniformity of distribution of moisture in soils, by P. E. Fuller | 169 |
| **Joint session of subsection 1 of Section III and subsection 2 of Section VII** | 188 |
| Petroleum and asphalt in the United States, by Eugene Wesley Shaw | 188 |
| Outline of the petroleum resources of Ecuador, by César D. Andrade | 203 |
| Conservation of the oil and gas resources of the Americas, by Ralph Arnold | 207 |
| The petroleum industry of Mexico, by David T. Day | 238 |
| **Joint session of subsection 1 of Section III and subsection 1 of Section VII** | 246 |




Digitized by Google

Page.
The conservation of copper, by W. H. Emmons..... 246
Conservation of metals by the recovery and use of scrap metals and drosses, by John P. Dunlop..... 253
**Joint session of subsection 4 of Section III and subsection 4 of Section V**..... 260
Irrigation and drainage, by F. H. Newell..... 260
Engineering work of the United States Reclamation Service, by Arthur Powell Davis..... 283
Irrigation work of the United States Indian Service, by W. M. Reed..... 292
The combination of water resources for irrigation and power development, by G. G. Anderson..... 297
**Joint session of subsections 2, 5, and 7 of Section III**..... 309
The function of live stock in agriculture, by George M. Rommel..... 309
The horse in rural industry and recreation, by Carl Warren Gay..... 315
Relation between wool and mutton production in North and South American sheep industries, by F. R. Marshall..... 319
Government control of grazing on the public lands, by Albert F. Potter..... 325
Great central markets for live stock and meats, by Louis D. Hall..... 335
Truck marketing on a large scale under cooperative principles, by N. P. Wescott..... 341
**Joint session of subsections 2, 4, 5, and 6 of Section III and subsection 8 of Section IV**..... 350
Interdependence of forest conservation and forestry education, by J. W. Toumey..... 350
Trabajos fitotécnicos y de experimentación agrícola en "La Estanzuela" República Oriental del Uruguay, by Alberto Boerger..... 361
Progress of agricultural science in Cuba, by J. T. Crawley..... 374
The agricultural college and the working farmer, by Kenyon L. Butterfield..... 382
**Morning session of subsection 7, December 31, 1915**..... 396
The advisability of collegiate courses on marketing and distribution, by T. N. Carver..... 396
Improved transportation service for perishable products, by G. C. White..... 400
Car-lot distribution, by J. S. Crutchfield..... 425
Trading in grain futures, by L. D. H. Weld..... 430
Transportation of perishable commodities—need of cooperation by shippers with carriers, by Eugene F. McPike..... 439
Opportunities afforded the railroads of the United States for profitable agricultural development work, by T. F. Powell..... 451
The extent and possibilities of cooperation, by C. E. Bassett..... 456
**Joint session of subsections 4, 5, and 7 of Section III**..... 460
The poultry industry; its importance in agricultural development, by Harry M. Lamon..... 460
What should be done for the settler, by I. D. O'Donnell..... 466
Uniform grades and standard packages, by C. T. More..... 468
Standardization of vegetables, by S. J. Cook..... 475
**Joint session of subsection 1 of Section III and subsection 1 of Section VII**..... 480
**Morning session of January 3, 1916**..... 481
Contribución a la exploración forestal en la Patagonia austral, by Cristóbal M. Hicken..... 481
South American forest resources and their relation to the world's timber supply, by Raphael Zon..... 483
The lesson of forestry in the Philippine Islands, by Maj. George P. Ahern..... 492
**Afternoon session of January 3, 1916**..... 503

Digitized by Google

Page.
Plant introduction opportunities open to all the Americas, by David Fairchild. 503
How an animal grows, by H. J. Waters..... 510
Securing settlers for private irrigation projects, by H. G. Shedd..... 518
**Joint session of subsections 1 and 3 of Section III**..... 525
Government control of minerals on public lands, by James F. Callbreath..... 526
Valuation of Federal coal lands, by Floyd W. Parsons and R. Dawson Hall.... 539
The valuation of water powers, by William J. Hagenah..... 546
**Joint session of subsections 5 and 6 of Section III**..... 572
Possibilities of intensive agriculture in tropical America, by O. F. Cook..... 573
Tropical varieties of maize, by G. N. Collins..... 579
The rôle of the dairy industry in a system of national agricultural development, by B. H. Rawl..... 585
Cattle raising and the meat industry in Southern Brazil, by Reynaldo Porchat. 591
Algo sobre la langosta (Schistocerca Americana) y la necesidad de una convención internacional para obtener su destrucción, by Juan J. Rodríguez Luna.. 596
The institute of tropical agriculture of the Pacific coast, by Herbert J. Webber.. 599
**Morning session of subsection 7, January 4, 1916**..... 603
The marketing of farm mortgage loans, by C. W. Thompson..... 603
Financing cooperative marketing associations, by W. H. Kerr..... 612
Modern retail merchandising, by C. C. Parlin..... 624
The development of a market news service, by Wells A. Sherman..... 635
A practical market system for our large cities, by G. V. Branch..... 642
Developing foreign markets for apples, by Clarence W. Moomaw..... 646
The principles and practices of cooperation applied to citrus production and distribution, by G. Harold Powell..... 665
**Joint session of subsections 1, 2, and 3 of Section VII with subsection 1 of Section III**..... 672
**Joint session of subsections 5 and 6 of Section III**..... 673
Catálogo de los peces perteneciente a la fauna de Guatemala, by Juan J. Rodríguez Luna..... 673
Conservación de las plantas industriales, by Rafael Piñol Batres..... 680
El manganeso en la capa arable del Uruguay, by J. Maimo Sarrasín..... 687
The prevention and eradication of destructive animal diseases and the effect upon agriculture and the meat supply, by Archibald R. Ward..... 702
Recent progress in the development of methods for the control and treatment of parasites of live stock, by B. H. Ransom..... 709
**Afternoon session of subsection 7, January 4, 1916**..... 720
Municipal terminal markets, by Cyrus C. Miller..... 720
The economic trend in wholesale methods of fruit distribution, by Arthur R. Rule..... 729
Influence of supply on prices, by A. U. Chaney..... 735
The economic value of the auction as a distributor of perishable commodities, by Victor K. McElheny, jr..... 740
Organization by consumers, by Herbert A. Smith..... 749
**Joint session of subsections 1 and 3 of Section III**..... 761
The Federal Government and the Nation's mineral resources, by W. C. Mendenhall..... 761
Principles of a Federal water-power policy for the public lands of the United States, by O. C. Merrill..... 768
The water-power resources of the United States, by M. O. Leighton..... 782
Coordination in the development of our water-power resources with other uses of water, by M. O. Leighton..... 787
**Morning session of subsection 2, January 5, 1916**..... 796

Digitized by Google

Page.
Actitud del gobierno en materia de bosques nacionales—Relación de la selvicultura con el desarrollo futuro de Centro y Sud América, by Elías Leiva Quirós ..... 796
Actitud del gobierno en materia de bosques nacionales—La relación de la selvicultura con el desarrollo futuro de Centro y Sud América, by Raúl Brin. 801
Actitud del gobierno en materia de bosques nacionales—Relación de la selvicultura con el desarrollo futuro de Sud América, by Horacio Echegoyen .... 805
El tambú y la muerte de las tacuaras en Sud-América, by A. de Winkelried Bertoni ..... 812
Forest problems and economic development in South America, by Raphael Zon. 815
Scientific forestry for Latin America, by Barrington Moore ..... 822
**Morning session of subsection 4, January 5, 1916** ..... 835
State aid to irrigation and swamp land reclamation projects, by C. E. Grunsky.. 835
Irrigation and public policy in Peru, by C. W. Sutton ..... 840
Public control of irrigation in the United States, by R. P. Teele ..... 855
The doctrine of riparian rights (in the western United States), by A. E. Chandler ..... 861
**Morning session of subsection 6, January 5, 1916** ..... 869
Cooperación panamericana en la cuarentena de las plantas, by Roberto Sundberg ..... 869
The great need for the establishment of competent bureaus for the study of injurious insects in all American countries, by L. O. Howard ..... 874
Dípteros nuevos parásitos de la schistocerca peregrina, by Carlos Nocedo ..... 877
Cooperación en el servicio cuarentenario de plantas entre los países panamericanos, by John R. Johnston ..... 884
Pan American cooperation in plant quarantine, by C. I. Marlatt ..... 888
**Morning session of subsection 7, January 5, 1916** ..... 905
Efectos de la apertura del Canal de Panamá, sobre la distribución de productos agrícolas, by Eduardo Carrasco Bascuñán ..... 905
The effective use of the Panama Canal in the distribution of products, by Charles J. Brand ..... 911
**Morning session of subsection 5, January 6, 1916** ..... 916
Convención internacional americana de policía veterinaria. Posibilidad de ajustarla en determinadas condiciones, by José León Suárez ..... 916
¿Es factible la reglamentación económica uniforme entre los diferentes países americanos para la prevención de la introducción y propagación de las enfermedades de los animales?—Prevención y extinción de las enfermedades que diezman a los animales, by Francisco Etchegoyen ..... 920
¿Es factible la reglamentación uniforme entre los diferentes países americanos para la prevención de la introducción y propagación de las enfermedades de animales?—Prevención y extirpación de las enfermedades destructoras de animales, by Rafael Muñoz Ximénez ..... 925
¿Es factible la reglamentación uniforme entre los diferentes países americanos para la prevención de la introducción y propagación de las enfermedades de animales? by Julio Besnard ..... 937
Prevención y extirpación de las enfermedades destructoras de animales by Julio Besnard ..... 937
Are uniform regulations feasible among the different American countries for the prevention of the introduction and dissemination of diseases of animals? by A. D. Melvin ..... 942
Adjournment sine die of Section III ..... 947

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# LETTERS OF TRANSMITTAL.

WASHINGTON, D. C., *May 31, 1917.*

SIR: Pursuant to the recommendation of the executive committee of the Second Pan American Scientific Congress, which was held in Washington December 27, 1915–January 8, 1916, and by the cooperation of the United States Congress (urgent deficiency bill, Sept. 8, 1916), the papers and discussions of that great international scientific gathering have been compiled and edited for publication under the able direction of the Assistant Secretary General, Dr. Glen Levin Swiggett. In this volume is contained the report of Section III, of which Mr. G. M. Rommel, of the executive committee, was chairman.

In my formal report, which has already been submitted, I enlarged upon the importance of the Second Pan American Scientific Congress, its large attendance, and the high quality of its papers and discussions. I will, therefore, in this letter, which, in slightly varied form, introduces each volume, make only a few general references.

All of the 21 Republics of the Western Hemisphere were represented by official delegates at the Congress. Unofficial delegates, moreover, from the leading scientific associations and educational institutions of these Republics presented papers and took part in its deliberations. The papers and discussions may be considered, therefore, as an expression of comprehensive Pan American scientific effort and possess, in consequence, inestimable value.

The Congress was divided into nine main sections, which, with their chairmen, were as follows:

I. ANTHROPOLOGY. W. H. Holmes.
II. ASTRONOMY, METEOROLOGY, AND SEISMOLOGY. Robert S. Woodward.
III. CONSERVATION OF NATURAL RESOURCES, Agriculture, Irrigation, and Forestry. George M. Rommel.
IV. EDUCATION. P. P. Claxton.
V. ENGINEERING. W. H. Bixby.
VI. INTERNATIONAL LAW, PUBLIC LAW, AND JURISPRUDENCE. James Brown Scott.
VII. MINING, METALLURGY, ECONOMIC GEOLOGY, AND APPLIED CHEMISTRY. Hennen Jennings.
VIII. PUBLIC HEALTH AND MEDICAL SCIENCE. William C. Gorgas.
IX. TRANSPORTATION, COMMERCE, FINANCE, AND TAXATION. L. S. Rowe.

These sections, in turn, were further subdivided into 45 subsections.

Over 200 delegates were in attendance from the Latin American Republics, while over a thousand from the United States participated in its meetings. The discussions and proceedings of the Congress attracted world-wide attention, and it was undoubtedly the greatest international scientific meeting that has assembled anywhere in the history of the Western Hemisphere and possibly of the world. It was, therefore, a fitting successor to the first Pan American Scientific Congress, which assembled in Santiago, the capital of Chile, in 1908, and to its predecessors, confined to Latin American representation, which in former years met, respectively, in Rio de Janeiro, Montevideo, and Buenos Aires. Its success was a logical result of these preceding gatherings in Latin America and of the hearty cooperation of the Latin American Governments and scientists.

To those who may have their attention brought only to the individual volumes covering the papers and discussions and who wish to know more of the proceedings of the Congress and the results accomplished by it, it is recommended that they should



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also read "The Final Act—An Interpretative Commentary Thereon," prepared under the direction of Dr. James Brown Scott, reporter general of the Congress, and the report of the secretary general, prepared by the latter and the assistant secretary general, Dr. Glen Levin Swiggett. In these will be found not only the final act and the illuminating comment thereon but lists of delegates, participating Governments, societies, educational institutions, and other organizations, together with a careful story and history of the Congress. They can be obtained by addressing the Director General of the Pan American Union, Washington, D. C.

In conclusion, I want to briefly repeat, as secretary general of the Congress, my appreciation, already expressed in my formal report, of the hearty cooperation in making the Congress a success given by everyone concerned from the President of the United States, yourself as Secretary of State, and the delegates of Latin America and the United States, down to the office employees. The great interest manifested by the permanent executive committee, headed by Mr. William Phillips, then Third Assistant Secretary of State, the Carnegie Endowment for International Peace through its secretary, Dr. James Brown Scott, and the executive aid of Dr. Glen Levin Swiggett, as assistant secretary general, were vitally instrumental in making the gathering memorable. The Pan American Union, the official international organization of all the American Republics, and whose governing board is made up of the Latin American diplomats in Washington and the Secretary of State of the United States, lent the favorable influence of that powerful organization to the success of the Congress and authorized me as the director general of the Union to also take up the duties of secretary general of the Congress.

Yours, very truly,

(Signed) JOHN BARRETT,
*Secretary General.*

The Honorable The SECRETARY OF STATE,
*Washington, D. C.*

---

WASHINGTON, D. C., *31 de maio de 1917.*

EXMO. SNR.: Em cumprimento de uma recommendação emanada da Commissão Executiva do Segundo Congresso Scientifico Pan Americano, que teve lugar em Washington, de 27 de dezembro de 1915 a 8 de janeiro de 1916, e, devido ao auxilio do Congresso dos Estados Unidos (Lei para Orçamentos extraordinarios de 8 de setembro, 1916) as memorias e as discussões dessa assembléa scientifica internacional, foram colligidas e preparadas para publicação sob a proficiente direcção do Secretario Geral Adjuncto, Dr. Glen Levin Swiggett. Este volume comprehende o relatorio da secção III que foi presidida pelo Snr. G. M. Rommel, da Commissão Executiva.

No meu relatorio official, que já tive a honra de apresentar, me detive sobre a importancia do Segundo Congresso Scientifico Pan Americano, da sua grande concorrencia e da alta importancia das theses e das discussões. Na presente nota, portanto, de uma maneira muito ligeira, destinada a apresentar cada um dos volumes, eu farei apenas algumas referencias muito geraes.

Todas as Republicas do Hemispherio Occidental, vinte e uma em numero, se achavam representadas por delegados officiaes ao Congresso. Delegados sem nomeação dos Governos, mas representando as mais notaveis sociedades scientificas e instituições de ensino dessas republicas apresentaram theses e tomaram parte nas deliberações. As memorias e discussões devem ser consideradas portanto, como a expressão de um justificavel trabalho scientifico Pan Americano e possue, por esse motivo, um valor sem egual.

O Congresso foi dividido em nove secções principaes, que a seguir enuméro, com os nomes dos seus presidentes:

I. ANTHROPOLOGIA. W. H. Holmes.

II. ASTRONOMIA, METEREOLOGIA E SISMOLOGIA. Robert S. Woodward.

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III. Conservação da Riqueza Nacional, Agricultura, Irrigação e Silvicultura. George M. Rommel.
IV. Instrucção. P. P. Claxton.
V. Engenharia. W. H. Bixby.
VI. Direito Internacional, Direito Publico e Jurisprudencia. James Brown Scott.
VII. Minas, Metallurgia, Geologia Practica e Chimica Industrial. Hennen Jennings.
VIII. Saude Publica e Sciencias Medicas. William C. Gorgas.
IX. Vias de Communicação, Commercio, Finanças e Impostos. L. S. Rowe.

Estas secções, por seu lado, eram subdivididas em 45 subsecções.

Mais de 200 delegados das Republicas da America Latina frequentaram as sessões emquanto os Estados Unidos se achavam representados por mais de mil pessoas. As discussões e os relatorios do Congresso attrahiram a attenção de todo o mundo e foi sem duvida a maior assemblea scientifica que se realizou no Hemispherio Occidental e talvez em todo o mundo. Foi sem duvida um idoneo continuador do Primeiro Congresso Scientifico Pan-Americano, que se celebrou em Santiago, capital da Republica Chilena em 1908 e das anteriores assembleas que previamente se tinham realizado, apenas com delegados da America Latina e que se reuniram em annos anteriores no Rio de Janeiro, Montevideu e Buenos Aires. O seu successo foi um resultado logico das reuniões previas na America Latina e do cordial concurso dos Governos da America latina e dos seus homens de sciencia.

A aquelles que não quizerem limitar-se a consultar os volumes que contém as memorias e as discussões e que desejarem conhecer alguma cousa mais dos trabalhos do Congresso e dos resultados por elle alcançado se lhes recommenda a leitura da Acta Final—a exposição geral concernente á mesma—publicada sob a direcção do Sr. Dr. James Brown Scott, Relator Geral do Congresso, e o relatorio do Secretario Geral, preparado pelo abaixo assignado e pelo Secretario Geral Adjuncto Sr. Dr. Glen Levin Swiggett. Nestes trabalhos encontrar-se-hão não sómente a acta final mas tambem um magnifico commentario, a lista dos delegados dos Governos que adheriram, sociedades, instituições de ensino e outras corporações, seguidas de uma cuidadosa historia do Congresso. Estes volumes continuam á disposição dos que os pedirem ao Director Geral da União Pan-Americana, Washington, D. C.

Em conclusão, eu desejo repetir, em duas palavras, como Secretario Geral do Congresso, o meu apreço e reconhecimento, que já tive occasião de exprimir no meu relatorio official, pela cordial cooperação que por todos me foi prestada para levar a bom exito este congresso, desde o Presidente dos Estados Unidos, V. Exa., como Secretario d'Estado, os Senhores Delegados da America Latina e dos Estados Unidos até os diversos funccionarios do Congresso. O grande interesse manifestado pela Commissão Permanente Executiva presidida pelo Sr. William Phillips, ao tempo terceiro Sub-secretario d'Estado, pelo Instituto de Carnegie para a Paz Internacional na pessoa do Sr. Dr. James Brown Scott, assim como a collaboração prestada pela Sr. Dr. Glen Levin Swiggett, como Secretario Geral Adjuncto, constituiram obras basilares para o successo desta reunião.

A União Pan-Americana, instituição internacional sustentada por todas as Republicas Americanas e cujo Conselho de Administração é constituido pelos representantes diplomaticos em Washington e pelo Secretario d'Estado dos Estados Unidos, contribuiu com a sua poderosa influencia para o bom exito do Congresso e me auctorizou a servir de Secretario Geral do Congresso.

Com a maior consideração, subscrevo-me

De V. Exa.
Vor. Mto. Atto.,
(Ass.) John Barrett,
*Secretario Geral.*

Exmo. Snr. Secretario de Estado,
*Washington, D. C.*

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WASHINGTON, D. C., *31 de mayo de 1917.*

SEÑOR:

En cumplimiento de una recomendación emanada de la Comisión Ejecutiva del Segundo Congreso Científico Panamericano que se reunió en Wáshington desde el 27 de diciembre de 1915 hasta el 8 de enero de 1916 y gracias a la cooperación al efecto prestada por el Congreso de los Estados Unidos mediante su ley sobre rectificación del presupuesto dictada el 8 de setiembre de 1916, hánse recopilado y preparado para su publicación, bajo la hábil dirección del Sr. Dr. Glen Levin Swiggett, Subsecretario General, las memorias presentadas a dicho Congreso y los debates a que dieron lugar. El presente volumen contiene el informe relativo a la Sección III, de la cual fué presidente el Sr. G. M. Rommel, miembro de la Comisión Ejecutiva.

En el informe general que ya tuve el honor de presentarle, me fué dable considerar detenidamemte la importancia del Segundo Congreso Científico Panamericano, la numerosa concurrencia que al mismo asistió y el elevado mérito de las memorias presentadas y de los debates que en aquel se suscitaron. Por consiguiente, he de limitarme en la presente, destinada a servirle de mera introducción a cada uno de los volúmenes, a algunas consideraciones de carácter general.

En el Congreso estuvieron representadas por medio de delegaciones oficiales las veinte y una repúblicas del Hemisferio Occidental. También asistieron al mismo, tomando participación en sus debates y presentando trabajos personales, delegados particulares de los principales cuerpos científicos y de los institutos docentes de esas mismas repúblicas. En tal virtud, las memorias y los debates mencionados deben ser considerados como la expresión de un amplio esfuerzo científico panamericano, encerrando, por lo tanto, un valor inestimable.

El Congreso estuvo dividido en nueve secciones principales que en seguida paso a enumerar junto con el nombre de sus presidentes. Fueron las siguientes:

I. ANTROPOLOGÍA. W. H. Holmes.

II. ASTRONOMÍA, METEOROLOGÍA Y SISMOGRAFÍA. Robert S. Woodward.

III. CONSERVACIÓN DE LAS FUENTES NATURALES DE RIQUEZA, AGRICULTURA, IRRIGACIÉN Y SELVICULTURA. George M. Rommel.

IV. INSTRUCCIÓN. P. P. Claxton.

V. INGENIERÍA. W. H. Bixby.

VI. DERECHO INTERNACIONAL, DERECHO PÚBLICO Y JURISPRUDENCIA. James Brown Scott.

VII. MINERÍA, METALURGIA, GEOLOGÍA ECONÓMICA Y QUÍMICA APLICADA. Hennen Jennings.

VIII. SALUBRIDAD PÚBLICA Y CIENCIA MÉDICA. William C. Gorgas.

IX. TRASPORTE, COMERCIO, FINANZAS E IMPUESTOS. L. S. Rowe.

Estas secciones estuvieron divididas, a su vez, en cuarenta y cinco subsecciones.

De las repúblicas latino-americanas asistieron más de doscientos delegados; en tanto que las sesiones del Congreso concurrieron más de mil personas de los Estados Unidos. Los trabajos y debates del cuerpo despertaron universal interés, pues indudablemente fué aquel la asamblea científica más grande que registra la historia del Hemisferio Occidental y probablemente la del mundo. Él fué, en consecuencia, digno continuador del Primer Congreso Científico Panamericano que en 1910 se reunió en la capital de Chile y de los que previamente y con una asistencia exclusivamente latino-americana se habían congregado en Río de Janeiro, Montevideo y Buenos Aires. Su éxito fué consecuencia lógica de las asambleas que anteriormente se habían reunido en la América latina y del cordial concurso que recibió de los gobiernos y de los hombres de ciencia de esa misma parte de América.

A cuantos no quisieren limitarse a consultar los volúmenes que contienen las memorias y los debates y desearen conocer algo más de las labores del Congreso y de los resultados por él alcanzados, se les recomienda la lectura del Acta Final y de la Exposición General concerniente a la misma que escribió el Dr. James Brown Scott, Informante General del Congreso, así como el Informe del Secretario General, prepa-

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rado por el suscrito y por el Dr. Glen Levin Swiggett, Subsecretario General del mismo. En estos documentos podrán hallar no sólo el Acta Final y luminosas consideraciones acerca de la misma, sino también la nómina de los delegados y de los gobiernos, sociedades e institutos docentes que tuvieron representación en la Asamblea, juntamente con una relación puntualizada de las labores de la misma. Los que deseen obtener estos volúmenes pueden solicitarlos del Director General de la Unión Panamericana en Wáshington, D. C.

Como Secretario General del Congreso deseo hacer constar una vez más, antes de concluir, el agradecimiento que en mi informe general expresé por el cordial concurso que de todos recibí para asegurar el éxito del Congreso, desde el Presidente de los Estados Unidos y usted mismo como Secretario de Estado y desde los delegados de la América Latina y de los Estados Unidos hasta los diversos funcionarios del Congreso. El gran interés desplegado por la Comisión Permanente Ejecutiva, que presidió el Sr. William Phillips, a la sazón Tercer Subsecretario de Estado; por la Fundación Carnegie para la Paz Internacional, por el órgano de su Secretario, Dr. James Brown Scott; así como la colaboración del Dr. Glen Levin Swiggett, Subsecretario General, contribuyeron poderosamente a hacer memorable la asamblea. La Unión Panamericana, institución internacional sostenida por todas las repúblicas de América y cuyo Consejo Directivo está formado por los representantes diplomáticos latinoamericanos residentes en Wáshington y por el Secretario de Estado de los Estados Unidos, contribuyó con su poderosa influencia al éxito del Congreso y me autorizó para que desempeñara las funciones de Secretario General de aquél.

Con sentimientos de la más alta consideración me subscribo

De usted muy atento servidor,

JOHN BARRETT,
*Secretario General.*

Al Honorable SECRETARIO DE ESTADO,
*Wáshington, D. C.*

---

WASHINGTON, D. C., *Le 31 mai 1917.*

MONSIEUR: Conformément à la recommandation du Comité Exécutif du Second Congrès Scientifique Panaméricain qui a eu lieu è Washington du 27 décembre 1915 au 8 janvier 1916, et par la coopération du Congrès des États-Unis (loi du budget extraordinaire, 8 septembre 1916), les mémoires et discussions de cette grande réunion scientifique internationale ont été recueillis et édités pour être publiés sous l'habile direction du docteur Glen Levin Swiggett sous-secrétaire général. Ce volume contient le rapport de la section III, dont M. G. M. Rommel du Comité Exécutif était président.

Dans mon rapport officiel qui a été déjà soumis, je me suis étendu sur l'importance du Second Congrès Scientifique Panaméricain, sur le grand nombre de personnes qui y étaient présentes et sur l'excellence de ses mémoires et de ses discussions. C'est pourquoi, dans cette lettre qui, après avoir subi quelques changements sans importance, sert d'introduction à chaque volume, je n'en parlerai que d'une manière générale.

Toutes les républiques de l'Hémisphère Occidental au nombre de vingt-et-une étaient représentées au Congrès. De plus, des délégués à titre officieux envoyés par les associations scientifiques et les institutions éducatives les plus en vue de ces républiques ont soumis des mémoires et ont pris part aux délibérations. On peut donc considérer les mémoires et les discussions comme l'expression d'un grand effort scientifique panaméricain, possédant en conséquence une valeur inestimable.

Le Congrès était divisé en neuf sections principales que nous énumérons ci-dessous, en donnant le nom de leurs présidents.

I. ANTROPOLOGIE. W. H. Holmes.

II. ASTRONOMIE, MÉTÉOROLOGIE ET SISMOLOGIE. Robert S. Woodward.

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III. Conservation des Ressources Naturelles, Agriculture, Irrigation et Forêts. George M. Rommel.

IV. Instruction Publique. P. P. Claxton.

V. Génie Civil. W. H. Bixby.

VI. Droit International, Droit Public et Jurisprudence. James Brown Scott.

VII. Mines, Métallurgie, Géologie pratique, et Chimie Appliquée. Hennen Jennings.

VIII. Santé Publique et Science Medicale. William C. Gorgas.

IX. Transport, Commerce, Finance et Impôt. L. S. Rowe.

A leur tour ces sections étaient subdivisées en quarante cinq sous-sections.

On y comptait plus de deux cents délégués des républiques latino-américaines, et plus de mille délégués des Etats-Unis ont assisté aux réunions. Les discussions et les procès-verbaux du Congrès ont attiré l'attention du monde entier, et il a été sans le moindre doute la plus grande assemblée scientifique internationale de l'histoire de l'Hémisphère Occidental, et peut-être même du monde entier, qui se soit réunie jusqu'ici. Venant après le Premier Congrès Scientifique Panaméricain qui s'est réuni à Santiago, capitale du Chili, en 1908, et après ceux qui ont eu lieu précédemment, respectivement à Rio de Janeiro, à Montevideo et à Buenos-Ayres, ces derniers n'ayant que des représentants de l'Amérique Latine, il s'est montré leur digne successeur. Sa réussite a été un logique résultat de ces précédents concours dans l'Amérique Latine et de la sincère et cordiale coopération des gouvernements et des hommes de science de l'Amérique Latine.

Pour ceux qui n'ont porté leur attention que sur les volumes renfermant les mémoires et les discussions, et qui désireraient connaître d'une manière plus approfondie les actes et procès-verbaux du Congrès, ainsi que les résultats qui s'en sont suivis, je leur conseillerai de lire "L'acte Final, Commentaire explicatif," rédigé sous la direction du docteur James Brown Scott, rapporteur général du Congrès, et le rapport du Secrétaire Général rédigé par ce dernier et le docteur Glen Levin Swiggett. En les lisant on n'y trouvera pas seulement l'Acte Final et le commentaire explicatif, mais encore les listes des délégués, des gouvernements qui ont participé au Congrès, des sociétés, des institutions éducatives et autres, en même temps qu'un compte rendu soigné ainsi que l'histoire du Congrès. On peut se les procurer en faisant une demande par écrit au Directeur Général de l'Union Panaméricaine à Washington, D. C.

En terminant, je vais en qualité de Secrétaire Général du Congrès exprimer de nouveau en peu de mots mes remercîments, ce que j'ai déjà fait dans mon rapport officiel pour la part que chacun a eue dans la réussite du Congrès depuis le Présiden des États-Unis, vous comme Secrétaire d'État, les délégués de l'Amérique Latine et ceux des États-Unis jusqu'aux employés de bureau. Le haut intérêt manifesté par le Comité Exécutif permanent présidé par M. William Phillips, qui était alors troisième Sous-Secrétaire d'État, par la Fondation Carnegie pour la Paix Internationale, par l'entremise de son sécretaire le docteur James Brown Scott, et l'aide prêté dans l'exécution par le docteur Glen Levin Swiggett, comme sous-secrétaire général, ont puissamment contribué à faire de ce Congrès un événement mémorable. L'Union Panaméricaine, administration officielle internationale de toutes les républiques américaines, et dont le Comité d'Administration est composé des diplomates latino-américains à Washington et du Secrétaire d'État des États-Unis, a usé de sa favorable influence pour assurer le succès du Congrès et m'a autorisé, en qualité de Directeur Général de l'Union, à prendre en mains les responsabilités de Secrétaire Général du Congrès.

Veuillez agréer, M. le Secrétaire d'État, en même temps que mes respectueux hommages l'assurance de mon entier dévoûment,

John Barrett,
*Secrétaire Général.*

Monsieur le Secrétaire d'État,
*Washington, D. C.*

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# REGISTER OF WRITERS OF PAPERS.


| | Page. |
|---|---|
| Adams, Frank | 162 |
| Ahern, George P | 492 |
| Anderson, G. G | 297 |
| Andrade, César D | 203 |
| Arnold, Ralph | 207 |
| Bassett, C. E | 456 |
| Besnard, Julio | 937 |
| Boerger, Alberto | 361 |
| Branch, G. V | 642 |
| Brand, Charles J | 911 |
| Briggs, Lyman J | 95 |
| Brin, Raúl | 801 |
| Butterfield, Kenyon L | 382 |
| Callbreath, James F | 526 |
| Carrasco Bascuñán, Eduardo | 905 |
| Carver, T. N | 56, 396 |
| Chandler, A. E | 861 |
| Chaney, A. U | 735 |
| Collins, G. N | 579 |
| Cook, O. F | 573 |
| Cook, S. J | 475 |
| Crawley, J. T | 374 |
| Crutchfield, J. S | 425 |
| Davis, Arthur Powell | 283 |
| Day, David T | 238 |
| Deutsch, Maurice | 142 |
| Dunlop, John P | 253 |
| Echegoyen, Horacio | 805 |
| Ely, Richard T | 10 |
| Emery, Henry C | 21 |
| Emmons, W. H | 246 |
| Etchegoyen, Francisco | 920 |
| Fairchild, David | 503 |
| Fortier, Samuel | 81 |
| Fuller, P. E | 169 |
| Galloway, Beverly T | 50 |
| Gay, Carl Warren | 315 |
| Graves, Henry S | 38 |
| Grunsky, C. E | 835 |
| Hagenah, William J | 546 |
| Hall, Louis D | 335 |
| Hall, R. Dawson | 539 |
| Harding, S. T | 121 |
| Hess, Ralph Henry | 26 |
| Hicken, Cristóbal M | 481 |
| Howard, L. O | 874 |
| Johnston, John R | 884 |




Digitized by Google

Page.
Kerr, W. H. ..... 612
Lamon, Harry M. ..... 460
Leighton, M. O. ..... 782, 787
Leiva Quirós, Elías ..... 796
Maimo Sarrasín, J. ..... 687
Marlatt, C. L. ..... 888
Marshall, F. R. ..... 319
McElheny, jr., Victor K. ..... 740
McPike, Eugene F. ..... 439
Melvin, A. D. ..... 942
Mendenhall, W. C. ..... 761
Merrill, O. C. ..... 768
Miller, Cyrus C. ..... 720
Moomaw, Clarence W. ..... 646
Moore, Barrington ..... 822
More, C. T. ..... 468
Muñoz Ximénez, Rafael ..... 925
Newell, F. H. ..... 260
Nocedo, Carlos ..... 877
O'Donnell, I. D. ..... 466
Paes Leme, Luiz Betim ..... 131
Parlin, C. C. ..... 624
Parsons, Floyd W. ..... 539
Piñol Batres, Rafael ..... 680
Porchat, Reynaldo ..... 591
Potter, Albert F. ..... 325
Powell, G. Harold ..... 665
Powell, T. F. ..... 451
Ransom, B. H. ..... 709
Rawl, B. H. ..... 585
Reed, W. M. ..... 292
Rodríguez Luna, Juan J. ..... 596, 673
Rommel, George M. ..... 309
Rule, Arthur R. ..... 729
Shantz, H. L. ..... 95
Shaw, Eugene Wesley ..... 188
Shedd, H. G. ..... 518
Sherman, Wells A. ..... 635
Smith, George Otis ..... 45
Smith, Herbert A. ..... 749
Suárez, José León ..... 916
Sundberg, Roberto ..... 869
Sutton, C. W. ..... 840
Teele, R. P. ..... 855
Thompson, C. W. ..... 603
Toumey, J. W. ..... 350
Ward, Archibald R. ..... 702
Waters, H. J. ..... 510
Webber, Herbert J. ..... 599
Weld, L. D. H. ..... 430
Wescott, N. P. ..... 341
White, G. C. ..... 400
Widtsoe, John A. ..... 107
Winkelried Bertoni, A. de ..... 812
...n, Raphael ..... 483, 815

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## FOREWORD.

The results of the deliberations of Section III of the Second Pan American Scientific Congress, which are outstanding in their character and which will have an important effect on the development of nternational relations between the American countries on subjects relating to agriculture, are the principles laid down for the conservation of natural resources, for the use of water in irrigation, and for uniformity in animal and plant sanitary and protection work. American international congresses which preceded the Second Pan American Scientific Congress had done important work along most of these lines and gave this section a basis for its deliberations. The recommendations of the section present, therefore, the principles of working plans for agricultural development and for the conservation of natural resources and of the industries immediately relating thereto.

The chairman takes this opportunity to express to the members of the various committees and other members of Section III, and to the authors of papers presented to the section, his sense of sincere obligation for the service rendered.

GEORGE M. ROMMEL, *Chairman.*



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# SECOND PAN AMERICAN SCIENTIFIC CONGRESS.

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GEORGE M. ROMMEL, Chief, Animal Husbandry Division, Bureau of Animal Industry, Department of Agriculture.
L. S. ROWE, Head Professor of Political Science, University of Pennsylvania.
ROBERT S. WOODWARD, President, Carnegie Institution of Washington.

## ORGANIZATION OFFICERS.

JOHN BARRETT, Secretary General.
GLEN LEVIN SWIGGETT, Assistant Secretary General.



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## SECTION III.—CONSERVATION OF NATURAL RESOURCES.

GEORGE M. ROMMEL, Chief, Animal Husbandry Division, Bureau of Animal Industry, Department of Agriculture, Washington, D. C., Chairman.
EDWIN W. ALLEN, Chief, Office of Experiment Stations, States Relations Service, Department of Agriculture, Washington, D. C., Vice Chairman.
RAYMOND A. PEARSON, President, Iowa State College, Ames, Iowa, Secretary.

### SUBSECTION 1.—*Conservation of Mineral Resources.*

M. R. CAMPBELL, Geologist in Charge, Western Mineral Fuels, U. S. Geological Survey, Washington, D. C., Chairman.
WALDEMAR LINDGREN, Professor of Economic Geology, Massachusetts Institute of Technology, Boston, Mass.
C. E. SIEBENTHAL, U. S. Geological Survey, Washington, D. C.
W. C. PHALEN, U. S. Geological Survey, Washington, D. C.

### SUBSECTION 2.—*Conservation of Forests.*

HENRY S. GRAVES, Chief, Forest Service, Department of Agriculture, Washington, D. C., Chairman.
J. W. TOUMEY, Professor, School of Forestry, Yale University, New Haven, Conn.
A. F. POTTER, Associate Forester, Forest Service, Department of Agriculture, Washington, D. C.
MAJ. GEORGE P. AHERN, 2806 Cathedral Avenue, Washington, D. C.

### SUBSECTION 3.—*Conservation of Water for Power.*

N. C. GROVER, Chief Hydraulic Engineer, Water Resources Branch, Geological Survey, Washington, D. C., Chairman.
HERMAN STABLER, U. S. Geological Survey, Washington, D. C.
M. O. LEIGHTON, Consulting Engineer, Washington, D. C.
E. C. FINNEY, Board of Appeals, Department of the Interior, Washington, D. C.
PHILIP P. WELLS, Attorney, Conservation Commission, Washington, D. C.

### SUBSECTION 4.—*Irrigation.*

SAMUEL FORTIER, Chief of Irrigation Investigations, Office of Public Roads and Rural Engineering, Department of Agriculture, Washington, D. C., Chairman.
C. S. SCOFIELD, In charge of Western Irrigation Agriculture, Bureau of Plant Industry, Department of Agriculture, Washington, D. C.
R. P. TEELE, Irrigation Economist, Office of Public Roads and Rural Engineering, Department of Agriculture, Washington, D. C.
C. W. SUTTON, Civil Engineer, 80 Maiden Lane, New York, N. Y.
A. F. CHANDLER, Member, State Water Commission, San Francisco, Cal.
I. D. O'DONNELL, Supervisor of Irrigation, United States Department of the Interior, Billings, Mont.



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SUBSECTION 5.—*Conservation of the Animal Industry.*

GEORGE M. ROMMEL, Chief, Animal Husbandry Division, Bureau of Animal Industry, Department of Agriculture, Washington, D. C., Chairman.
B. H. RANSOM, Chief, Zoological Division, Bureau of Animal Industry, Department of Agriculture, Washington, D. C.
F. R. MARSHALL, In charge of Sheep and Wool Investigations, Bureau of Animal Industry, Department of Agriculture, Washington, D. C.
J. R. MOHLER, Assistant Chief, Bureau of Animal Industry, Department of Agriculture, Washington, D. C.
H. W. MUMFORD, Professor of Animal Husbandry, University of Illinois, Urbana, Ill.
B. H. RAWL, Chief, Dairy Division, Bureau of Animal Industry, Department of Agriculture, Washington, D. C.
H. J. WATERS, President, Kansas State Agricultural College, Manhattan, Kans.

SUBSECTION 6.—*Conservation of the Plant Industry.*

DAVID FAIRCHILD, Agricultural Explorer in Charge of Foreign Seed and Plant Introduction, Bureau of Plant Industry, Department of Agriculture, Washington, D. C., Chairman.
L. O. HOWARD, Chief, Bureau of Entomology, Department of Agriculture, Washington, D. C.
N. A. COBB, Agricultural Technologist, Bureau of Plant Industry, Department of Agriculture, Washington, D. C.
H. J. WEBBER, Director, Citrus Station, University of California, Berkeley, Cal.
G. N. COLLINS, Bureau of Plant Industry, Department of Agriculture, Washington, D. C.
C. L. MARLATT, Chairman, Federal Horticultural Board, Department of Agriculture, Washington, D. C.

SUBSECTION 7.—*Marketing and Distribution of Agricultural Products.*

CHARLES J. BRAND, Chief, Office of Markets and Rural Organization, Department of Agriculture, Washington, D. C., Chairman.
G. HAROLD POWELL, Manager California Fruit Growers' Exchange, Los Angeles, Cal.
L. M. ESTABROOK, Chief, Bureau of Crop Estimates, Department of Agriculture, Washington, D. C.
JOHN J. DILLON, Commissioner, Department of Foods and Markets, New York, N. Y.
J. S. CRUTCHFIELD, President Crutchfield & Woolfolk, Pittsburgh, Pa.
CLARENCE POE, Editor The Progressive Farmer, Raleigh, N. C.

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## SECOND PAN AMERICAN SCIENTIFIC CONGRESS.

### AIMS AND PURPOSES.

The congress, in accordance with its high aims and purposes—namely, to increase the knowledge of things American, to disseminate and to make the culture of each American country the heritage of all American Republics, to further the advancement of science by disinterested cooperation, to promote industry, inter-American trade and commerce, and to devise the ways and means of mutual helpfulness in these and in other respects—considered the following general program of subjects, divided into appropriate sections and subsections.

#### SECTION III.—CONSERVATION OF NATURAL RESOURCES, AGRICULTURE, IRRIGATION, AND FORESTRY.

#### THE ECONOMICS OF CONSERVATION AND THE RELATION OF THE GOVERNMENT THERETO.

The economic principles underlying a sound conservation policy; the economics of future trading in agricultural commodities; public conservation policies; the Government and the marketing problem; the conservation of human life.

#### THE CONSERVATION OF MINERAL RESOURCES.

Mine accidents, and mine-rescue work; the conservation of coal and other minerals, petroleum, and gas; the conservation of metals by the use of scrap or used metals; improved mining and metallurgical methods as an aid to conservation; the rôle of Government in the conservation of mineral resources.

#### THE CONSERVATION OF FORESTS.

The forest resources and the forest botany of South America; forestry in the Philippine Islands; forest problems in the American countries; education in forestry; a national forest policy; the attitude of the Government in forest conservation.

#### THE CONSERVATION OF WATER FOR POWER.

The value of water power; the present status of water-power development; hydroelectric utilization of water power; electrochemical industries; public policies and legislation regarding the use of water and water-power resources; public control of water-power resources.



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### IRRIGATION.

Irrigation development in the United States, Peru, and other American countries; the principles and practice of the use of water in irrigation; irrigation districts; securing settlers for irrigation projects; the use of irrigation waters as sources of power; the relation of riparian rights to the utilization of streams for irrigation; Government participation in irrigation and drainage development.

### CONSERVATION OF THE ANIMAL INDUSTRY.

The function of live stock in agriculture; the rôle and importance of the live-stock, dairy, and poultry industries in agricultural development; the relation between wool and mutton production in the sheep industry of the American countries; Government control of grazing on public lands; the effect of animal diseases and parasites—their control and eradication; are uniform regulations feasible among the different American countries for the prevention of the introduction and dissemination of diseases of animals?

### CONSERVATION OF THE PLANT INDUSTRY.

Experiment-station work in the American countries; subtropical and tropical agriculture in the Americas; plant introduction; Pan American cooperation in plant quarantine.

### MARKETING AND DISTRIBUTION OF AGRICULTURAL PRODUCTS.

The principles and practice of cooperation; extent and possibilities of cooperation; standardization of agricultural products; uniform grades and standard packages; transportation of perishable commodities; car-lot distribution; the marketing of farm mortgage loans; financing cooperative marketing associations; the extension of markets; the development of a market news service; the advisability of college courses in marketing and distribution; provisioning municipal populations; the Panama Canal—the effect of its opening upon the traffic in agricultural products and its effective use in the distribution of products in general.

## RESOLUTIONS AND RECOMMENDATIONS.

The Second Pan American Scientific Congress considered and discussed the subjects set forth in its program in the light of an intellectual Pan Americanism in a series of meetings from December 27, 1915, to January 8, 1916, and adopted resolutions and recommendations pertinent to the work of the nine main sections of the congress.

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The following recommendations refer to Section III:

ARTICLE 9.

The Second Pan American Scientific Congress recommends that a cooperative study of forest conditions and of forest utilization be undertaken by governmental agencies of the American Republics and that data thereon be published.

ARTICLE 10.

The Second Pan American Scientific Congress recommends that each of the American Republics appoint a commission to investigate and study in their respective countries the existing laws and regulations affecting—

(*a*) The administrative practice of regulating the use of water. (*b*) The adjudication of rights pertaining to the use of surface and underground water for irrigation purposes. (*c*) The distribution, application, and use of water upon arid and irrigable lands. (*d*) Methods of conservation of surface and underground waters for irrigation or industrial purposes.

And to suggest laws or regulations in the interest of general industry, navigation, and commerce.

ARTICLE 11.

The Second Pan American Scientific Congress suggests that the question of the reclamation of arid lands is one that should receive immediate and careful consideration of the Governments of the American Republics, to the end that there may be increased areas of productive lands to meet the needs of their increasing populations.

ARTICLE 12.

The Second Pan American Scientific Congress recommends that—

(*a*) Each country should maintain a well-organized and competent live-stock sanitary service comprising executive officers, field inspectors, and a laboratory force.

(*b*) Each country should enforce live-stock sanitary laws and regulations with the view of preventing the exportation, importation, and spread within the country of any infectious, contagious, or communicable animal disease by means of animals, animal products, ships, cars, forage, etc.

(*c*) Each country should maintain a thorough live-stock sanitary survey to determine what communicable diseases of animals are present and the localities where they exist. This information should be furnished regularly to each of the other countries at stated periods as a matter of routine.

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(*d*) Each country should refrain from exporting animals, animal products, forage, and similar materials which are capable of conveying infectious, contagious, or communicable animal diseases to the receiving country.

(*e*) Each country should enforce measures to prohibit the importation of animals, animal products, forage, and other materials which may convey diseases from countries where dangerous communicable diseases, such as rinderpest, foot-and-mouth disease, and contagious pleuropneumonia exist, and which have no competent live-stock sanitary service. Animals, animal products, forage, and similar materials from countries maintaining a competent live-stock sanitary service may be admitted under proper restrictions, regulations, and inspection, imposed by the importing country.

(*f*) Each country, through its live-stock sanitary service, should endeavor to control, and, if possible, eradicate the communicable animal diseases existing therein. There should be an exchange of information as to the methods followed which have proved most successful in combating animal diseases.

(*g*) Members of the live-stock sanitary service of the American Republics should meet at regular intervals to consult and inform each other regarding the measures taken for furthering cooperation in protecting the live-stock industry of the American countries.

ARTICLE 13.

The Second Pan American Scientific Congress suggests that an American plant-protection congress be convened as soon as practicable, composed of one or more technical experts from each of the American Republics, in order—

(1) To discuss suitable legislation.

(2) To provide the means of establishing competent scientific bureaus.

(3) To recommend such cooperative research work and control of plant introduction as may be advisable.

(4) To make all reasonable effort to secure appropriate action by the American Republics.

ARTICLE 14.

The Second Pan American Scientific Congress recommends the distribution of information regarding the agricultural production of the American Republics and of the publications relating thereto.

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## FIRST GENERAL SESSION OF SECTION III.[1]

### CONSERVATION OF NATURAL RESOURCES.

RALEIGH HOTEL,
*Tuesday morning, December 28, 1916.*

Chairman, GEORGE M. ROMMEL.

The session was called to order at 9.30 o'clock by the chairman.

Papers presented:

Conservation and ecomonic theory, by Richard T. Ely.

The economic bearing of future trading in agricultural commodities, by Henry C. Emery.

Conservation in its relation to industrial evolution, by Ralph Henry Hess.

## CONSERVATION AND ECONOMIC THEORY.

By RICHARD T. ELY,
*Professor of Political Economy, University of Wisconsin.*

### I. CONSERVATION DEFINED AND DESCRIBED.

*Conservation means preservation, improvement, justice.*—Conservation, narrowly and strictly considered, means the preservation in unimpaired efficiency of the resources of the earth; or in a condition so nearly unimpaired as the nature of the case, or wise exhaustion, admits. And broadly considered, it means more than the word itself implies, for it naturally includes an examination of methods whereby the natural inheritance of the human race may be improved; and still more broadly considered—and as used in popular discussion—it includes a treatment of the effects of productive conservation measures upon distribution. We shall give our attention briefly to the main points in this informal definition before we pass on to the thesis that conservation is largely a matter of property relations—that a wise conservation policy means wise property relations.

*Preservation of natural resources.*—First, conservation suggests simply preservation, and in the treatment of the subject which we have had in the United States, emphasis has been laid upon the past and present waste of natural resources and upon the means of putting a stop to this waste. The forests have been depleted; soil has been washed by rapidly flowing surface water from mountain sides. These rapidly flowing waters have produced high

[1] There was no stenographic report of this meeting.



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streams and devastating inundations, followed by low streams and impeded navigation. The forests have, moreover, been so removed as to bring great danger of fire, and destructive conflagrations have resulted in large waste of resources, including in some cases a destruction of the humus, supplying essential elements in the fertile soil. As a remedy we must have measures to reforest mountain sides, and this means large social control, very frequently taking the form of public ownership and management; but in addition we always find actual and proposed measures of cooperation with private owners. Illustrations are afforded by the services of publicly employed foresters in giving advice and in making plans, etc. Here the main emphasis is on cessation of waste and restoration of natural advantages. This means a great deal and involves hard tasks. It is said that there are places in southern Europe where it will take 300 years to restore the soil washed from the mountain sides, as it is necessary to begin at the bottom and by planting trees gradually to build up a fertile soil from falling leaves, decaying vegetation, etc.

Another feature of the existing situation much discussed is the enormous waste of good soil by the erosion of water, even in the more level portions of the earth's surface, as in the Mississippi Valley, where millions upon millions of tons of elements of fertility are being annually wasted—washed into this turbulent stream. It has been proposed to construct at public expense mighty reservoirs to check the rapidity of flow and to hold back the soil, which would also facilitate navigation. Here is one suggestion, and without entering into the extent of its possibilities, it is again apparent that emphasis is laid on preservation as nearly unimpaired as possible, as careful an exhaustion of supply as the nature of the case admits.

*Improvement of natural inheritance.*—But, in the second place, we are concerned with measures to improve the natural inheritance of the race, and this is brought out more or less fully in discussions of conservation. Under a rational system of forestry it is claimed that an acre of ground will produce two or three times as much in a given period of time as the same acre in a wild state of nature, when the trees are allowed to grow up naturally without man's care. Conservation of water adds to the fertility of the soil or at any rate brings about a better utilization of the fertile elements when the water is applied to the land in irrigation. Modern agriculture, which is at least partially included in discussions of conservation, is not content with the maintenance of an existing status, but wants to improve what is. Nearly everything needed to accomplish this purpose may be found in the land itself, or placed there by cultivating green crops and plowing them under, and perhaps extracting from the air elements of fertility to be united with the soil. The phosphates and potassium seem to be the main, if not the only, elements which must be added from without and which are in no physical proximity to the land, generally speaking. It must be admitted that the supplies of these are far more limited than we could wish, although it is highly probable that now unknown sources of supply will be discovered. Certainly there is no ground for present alarm, and for this assurance there are several reasons. With a general appreciation of the natural scarcity of these elements, economy in their use will be practised to a greater extent than previously, and this economy will be further promoted by an increase in price, accompanying growing scarcity. The natural result will be to establish something approximating a cycle, whereby these elements can be returned to the land again and again. We see something of this sort in countries like China and Japan. We are, therefore, warranted in the belief that for an indefinite time to come, certainly for several centuries, the productivity of the land may be maintained and even increased.

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*Conservation concerned primarily with production.*—In the third place, we observe that conservation considered as a part of economics has to do first of all with that division of economics which we call production; not with production in the technical sense, but in the social sense; in other words with relationships arising out of the efforts of men, associated to produce wealth. The question here has to be asked what institutions or what shaping of institutions is most favorable to conservation? Here, as elsewhere in economics, we have to do with property and contract, and find we can not make much progress until we have adopted the social theory of property and the social theory of contract.[1]

*Justice in distribution.*—And, in the fourth place, conservation takes cognizance of distribution and aims to bring about justice, as the conservationists see it. In general, it may be said that the conservationists wish to cut off, or at least reduce, the private receipt of property and income beyond what is a fair return to capital and labor and enterprise, reserving the surplus for public use.

Notice that we now get beyond the limits of conservation, strictly speaking, and are quite within the field of economics, but it would be arbitrary to stop the discussion at this point, where it yields fruitful results. This simply shows that conservation is in large part economics, one of our fundamental theses.

Conservationists seek to control franchises for the use of water power with this end in view, exacting payments for the public treasury in cases where otherwise we would have surplus value. They wish also a complete public control of mineral treasures, brought about by leases for the exploitation of these treasures when in public ownership, so that the lessees may receive no more than fair competitive gains; but some conservationists are inclined to look favorably upon at least a limited public operation of mines as well as ownership. The distribution of wealth and income is then always included as an aim in thorough conservation discussions.

*Conservation includes two orders of inquiry.—The first belongs to the natural sciences.*—But when we reflect seriously on the subject of conservation, we see that we have to do here with two orders of inquiry: One of them falls within the broad field of the natural sciences; the other is economic in nature and is concerned with property relations.[2] The geologist must instruct us about the formations of mineral treasures, about their amounts so far as actually known and so far as they may be estimated, about exhaustibility, etc. The scientific agriculturist deals with the cultivation of the soil and discusses methods for the maintenance and even increase of agricultural productivity.[3] Men who understand the natural laws governing the growth of trees are absolutely required if we would frame a wise forest policy. It is a question of natural science to determine the relative amounts of forest products which can be expected under low and middle and high forest culture, all involving different periods of time.

*The second order of inquiry is economic.*—But chief emphasis must be laid on the too much neglected question of property relations. Is the system of

[1] The limits of space and time prevent an elaboration of these theories, and this is the less necessary as I have discussed them elsewhere. See my Property and Contract, Book I. Part I, Chap. VI and Part II, Chap. V.

[2] It is recognized that in certain of its features, conservation has to do with political science and sociology. Here and now we must confine ourselves to economics as that one of the social sciences with which we are chiefly concerned in conservation.

[3] The maintenance of productivity and conservation of elements are two different things, but it would take us too far into scientific agriculture to discuss this distinction here.

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leasing public land to private parties favorable in the case of mines? We have to do in this case with the relations of public property to private operation and to private property in the implements of operations. Shall the Federal Government, the States, cities, and other local political units acquire private lands for forestry? Here we are concerned with the extension of public property in land and the corresponding contraction of private property in land. How shall we encourage oyster culture? Shall we make the beds of bays and rivers and bodies of water where oyster farming is feasible private property? If so, we extend private property and contract correspondingly public property. Shall we reserve public property in underwater land and encourage oyster farming and similar production of other sea-food by a system of leases which will encourage private investments of capital? Again, we are concerned with property relations. It is in the property relations most suitable for conservation that the chief difficulty arises; and it is on this account that the chief rôle in conservation belongs to the political economists, who must cultivate more diligently than heretofore that part of their field which we may designate as economic jurisprudence. When we decide upon what we want so far as property relations are concerned, engineers and other technical men will be able to carry out the desired policy, and political science, including administration, must be called on for aid. Oyster farming will flourish when we devise and put in force right property relations, and it will furthermore flourish without the establishment of injurious private monopolies.

Irrigation furnishes also an excellent illustration. The Government of the United States has encouraged technical investigation. Much effort, and very properly, has been put upon ascertaining the underground flow of water and what is called the duty of water, i. e., the work which a given quantity of water may accomplish, the aim being to avoid waste and accomplish the maximum of effect with the minimum of effort. The questions of when and how to apply the water are involved here; and many other technical questions, some of them purely engineering, some of them primarily agricultural, could be mentioned. These are technical and essential. But litigation has been prominent and in some parts of the country has ruined many a farmer, resulted in mutual hatred of neighbors, and occasionally even bloodshed has been a consequence, while an appreciable proportion of the benefits of improved farming by means of irrigation has been swallowed up in the needless costs, direct and indirect. And the vital question of property relations was neglected in the meantime, one great department, the Department of Agriculture, at one time even taking a discouraging attitude toward economic study. However, this has all been changed under the efforts of the present Secretary of the Department of Agriculture. Now, when property relations are settled, the rest becomes comparatively easy.

The United States Government in the Reclamation Service has not neglected property relations so far as its projects are concerned, for they are based on a rearrangement of property relations in the interest of the public and the parties immediately interested. I refer here to the giving up of old "priorities" so as to promote a better distribution of water.

Did time permit, it would be instructive to follow this discussion of the nature of conservation with a brief historical survey, showing first of all what political economists have done for conservation, and how the ground was prepared for the modern conservation movement; secondly, describing the connection which has existed between the work of scientific foresters, such as Dr. B. E. Fernow, Gifford Pinchot, and others with the conservation movement; and thirdly, outlining the services of those men who, under the leader-

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ship of ex-President Roosevelt, made the program of conservation a vital force in the United States. But as it is, such a historical sketch must be omitted; and so we proceed at once to a discussion of some leading economic principles of conservation.

## II. SOME ECONOMIC PRINCIPLES OF CONSERVATION.

Conservation in its economic aspects has such a wide sweep that it is difficult to lay down many principles of universal application, but several can be elaborated which have very far-reaching applications. But before we call attention to certain general principles, we ask on the very threshold of our inquiries that you should consider this simple question, "What is waste?" The question is simple; the answer is in many cases extremely difficult. The Century Dictionary has over two columns devoted to the word waste as noun, adjective, and verb, but does not satisfactorily answer our question. Under the verb I find this: "To expend without adequate return." That is, at any rate, helpful. You see apples decaying on the ground in my orchard. You ask, "Why this waste?" If I reply, "It will take $2 worth of time to gather $1 worth of apples," are you satisfied that there is no economic waste? But this is precisely the case with a great deal of what the conservationist frequently calls waste. Now I shall not attempt a definition of economic waste, but I hope that the remainder of this paper will throw some light on the question, and will show that often we must choose between destruction of a proportion, larger or smaller, of natural resources and a loss of human well-being; and as the natural world exists for the human world, we know how we must decide when the issue is clear-cut between the two.

Conservation means in a large number of cases what economists usually designate as intensive as opposed to extensive use. Now intensive use means in general high price. This is true in agriculture—excellent fences, careful cultivation of the corners of field and the edges near the fences, if there are fences; also fields entirely free from weeds, which means the hoe as well as the horse cultivator. It means going beyond the point of increasing returns to decreasing returns in most cases. Nearly if not quite everywhere in the United States the intelligent farmer stops when to go further decreases his net money income; this means in a new country very often that the hoe is never used, that the edges of fields are ragged, that fences are not so neat in appearances as esthetic interest would demand.

*The higher the price of land the better the farming in the absolute sense.*[1]—Warren in his Farm Management comes back again and again to high price as a cause of good farming. A soiling system—i. e., bringing the feed to cows—is conservation in the sense that it means more return per acre; but Warren says truly, "The labor of hauling the feed and manure, to say nothing of the cost of growing the crops, would more than pay the pasture bill on most dairy farms. It is evident that land and milk must be very high in price, before a soiling system will pay" (p. 179). And we find the following observation in the chapter on "Maintaining the Fertility of the Land":

We have good years and poor years, but crop yields are increasing very rapidly. All that is necessary to have them go up still further is to pay the farmer more for his produce. By bringing in land that is now little used,

[1] It is the high price of land rather than the high price of the products from the land that is the cause of good farming and intensive farming. It is important to bear this distinction in mind, but we can not here enter into all the refinements of theory which flow from this distinction. Historically and generally, it is believed that the two go together.

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and by better methods of farming, that are already known to farmers, it would probably be possible to increase our total production of crops 50 per cent in three years if the farmer could be assured of prices high enough to warrant the expense involved.[1]

Undoubtedly it is true that without an increase in price, something may be done to increase yield. Sometimes farmers are more intensive than they can afford to be, but generally not so much so. The following from Warren is a correct generalization: "The farmer's problem is to intensify his business up to the point of greatest profit for his conditions. Since conditions are gradually changing in favor of more intensive methods; and since there is a tendency for the average person[2] to lag behind, it follows that a little more intensive methods than the average of the community will usually be best" (pp. 179-180). But observe methods are changing to favor intensive farming because land prices are higher.

Another thing to be noticed is that improvement in knowledge and art increases the profitable intensivity of farming. We learn how to increase yields at a given price.

In what has been said we have a partial explanation of the intensive dairy farming which may be seen in parts of Europe—e. g., near Frankfort on the Main. But we have only a part of the explanation. Low wages are another part of the explanation; for, other things being equal, the higher wages are, the less intensive is that farming which is profitable; the lower wages are in a given state of the arts, the better the farming which is profitable.[3] High wages encourage the use of machinery, and this is a partial offset, but only a partial offset to high wages. If wages could be cut one-third and the labor supply increased correspondingly, we should witness an improvement in farming which would be in the direction of conservation of natural resources and would please the esthetic eye; but observe it is a conservation of natural resources which is at the expense of human resources.[4]

*The conservation of human resources limits the conservation of natural resources.*—Now this can be illustrated endlessly, in mining, as well as in agriculture. If we save all the ore taken from the mines in the Mesaba region in Minnesota, the price of iron ore must increase very materially or wages must fall, or both effects must be produced and either one means lessening real incomes of the community at large. As in farming, somewhat more economical methods could doubtless be employed at present prices for ore and present wages; but at best great waste of natural resources must continue—i. e., a great deal of the ore must remain unutilized.

Conservation of natural resources everywhere finds its sharp limitations in human resources—i. e., in human well-being.

Once again, conservation means a sacrifice of the present generation to future generations, whenever it is carried far, this conflict beginning far before the point is reached which conservationists are inclined to advocate.

This is implied in what we have already said. High prices and low wages, or even high prices with present or higher wages, mean a sacrifice of the in-

[1] Warren: Farm Management, pp. 183–184.

[2] It is not a question of averages. Many lag behind and for all these better farming would be profitable.

[3] High prices and low wages result in increased intensivity by drawing rent up. It is high rent with high land values that makes intensive farming profitable.

[4] Economic theorists will want to elaborate further and qualify the statement. High prices and low wages would in some cases result in larger scale and less intensive culture; but what is said here holds as a general statement. Rents would usually increase. Movements of population must be considered if we are to make our theory complete; but to do this would mean an immense enlargement of the present paper.

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terests of the present consumer. How shall we balance the interests of the present and the future? If we put them on absolutely the same plane, we could with propriety forego all use of the exhaustible natural resources like petroleum and natural gas; it would be at any given moment of time indifferent whether or not we used them, and they might remain forever unused—a reductio ad absurdum.

Perhaps the best article on the economic theories involved in conservation is that written by Prof. L. C. Gray, which appeared in the Quarterly Journal of Economics for May, 1913, under the title, "Economic possibilities of conservation." Prof. Gray finds "the real heart of the conservation problem" in "the conflict between the present and future" (p. 499). He says that "the primary problem of conservation expressed in economic language, is the determination of the proper rate of discount on the future with respect to the utilization of our natural resources." He then continues as follows:

> Some discount of the future, there must be. If society reduced the discount on the future to zero, the period of utilization would be increased to infinity; and therefore, the amount of present use would become infinitesimal. Conservation as a single principle of action involves the equal importance of future wants and present wants. It requires that the want of the infinitely distant future shall be as important as the want of the immediate present. Conservation as a single principle of action is reduced to an absurdity (p. 515).

This is precisely the conclusion we have reached. Any positive, statistical, and mathematical solution is an impossibility, because the solution, as Prof. Gray also points out, depends in the final analysis upon questions of individual social philosophy. What is the purpose of existence? the source and nature of ethical obligation? our duties to posterity? all questions of the gravest import and beyond the range of economic science. But taking as a basis the ethical notions and sentiments of normal men, or perhaps those somewhat above the average man, we can find guiding principles and helpful suggestions in economic theory which we must apply as best we can in concrete cases in their infinite complexity.

Now, as one of the first steps in conservation policies, we must classify natural resources, because they differ markedly with respect to the intensity of the conflict between present and future interests. Some natural resources may be maintained forever or at least indefinitely with use; others may possibly be increased indefinitely while being used; others show increasing scarcity and exhaustibility; and where supply is so sharply limited in proportion to demand that we begin to feel the effects of coming exhaustion and where no renewal is possible, we have the sharpest conflict between present and future. Let us for our present purposes adopt the classification of Prof. Gray, which as made by an economist is especially adapted to the purposes of economic discussion.

Natural resources may be classified as follows:

I. Resources which exist in such abundance that there is no apparent necessity for economy, either in present or future. For instance, water in some localities.

II. Resources which will probably become scarce in the remote future, although so abundant as to have no market value in the present. For instance, building stone and sand in some localities.

III. Resources which have a present scarcity:

1. Not exhaustible through normal use: Water powers.
2. Necessarily exhausted through use, and nonrestorable after exhaustion: Mineral deposits.
3. Necessarily exhausted through use, but restorable: Forests, fish.

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4. Exhaustible in a given locality but restorable through the employment of other resources of a different kind or of similar resources in different locations: Agricultural land[1] (pp. 499–500).

Interest represents the difference between present and future to the individual. It has been said in the economy of the State, as in publicly owned forests, interest does not enter, that it is a concept in distribution of income among private persons; but, however this may be, we can not avoid the recognition of differences between present and future. Can it be asked that we should do more than discount the future at the lowest possible rate of interest paid by a prosperous State with well-managed finances, say 2 per cent? I throw this out as a suggestion. It is only a little bit of a sidelight on the complicated problem.

It is essential at this point that we consider the case of copper and other natural resources which are probably fundamental conditions of permanent national existence. Even if there is some doubt about this, so long as it is at all probable that any national resource is essential to the continued and permanent existence of the nation, this resource occupies a peculiar condition. It is a first principle of political science that the State has perpetual life. States have perished in the past, but political and economic science can not take into account the possibility that our own national life will ever cease to exist. All wise plans must be based upon the hypothesis of continued national existence. Now in a case of this kind the future value of the natural resources rises to infinity, and however much we discount the future, we must still practice conservation. We must attempt so to utilize every natural resource of this kind that it may last as long as possible, using it now and using it hereafter for as long a time as possible. I think here in reality the interest rate cuts no figure. When we consider resources of this sort, we find that in their case the definition given by President Van Hise at the close of his book is applicable: Conservation means "the greatest good to the greatest number—and that for the longest time."[2]

There has been some discussion as to whether in agriculture we want the largest product per man or per acre. In general, it is doubtless true that the chief determinant should be the quantity produced per man. But the principle just laid down leads to certain qualifications. We have to consider not only the quantity produced per man now, but the welfare of future generations, and especially must we consider the condition of the country at war. The conservation of natural resources has to be regarded from a national point of view. No nation can consider it otherwise at the present time. From the German point of view we can see that it was important that Germany should sacrifice, as she did, something from the largest possible production per man to increase the production per acre. Conditions in Ireland also show that in the interest of present and future generations we can not decide solely with reference to the largest production per man.

Adequate conservation in general means a course of conduct in economic affairs which is dictated by the common interest, but which will not be followed by the private persons under a system of laissez faire, or nonintervention.

The complaint of the conservationists is precisely this—that the individual does not, as a matter of fact, conserve natural resources. What is going to induce the private person to follow the desired course of economic conduct?

[1] In a footnote Prof. Gray says: "In terminology the above classification resembles one proposed some years ago by Prof. B. E. Fernow. See his Economics of Forestry (p. 10). In detail, however, the classification differs widely" (p. 500).

[2] C. R. Van Hise: The Conservation of Natural Resources in the United States, p. 329.

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We consider among various possibilities this: The individual through ignorance fails to follow a socially desirable course of economic conduct, when it would be in his own interest. We have already seen that often, perhaps in most cases, the individual could be more careful, more painstaking, more intensive in the sense of conservation—for not all intensive uses mean conservation. We have, as a remedy against ignorance, education, and education can discover many new ways of conserving, to a greater degree than at present, all natural resources.

Even with respect to the present, education, if properly directed, will result in a diminished waste of economic goods. Psychical development fails to keep pace with economic changes. A highly educated woman, a missionary who had long worked in Turkey-in-Asia, was asked by a ladies' society in Buffalo what impressed her most on her return to her native land, and she replied, "Your garbage pails." She saw in them sinful waste—good food thrown away in a single city which would nourish thousands and perhaps even ten thousands of half-famished people in Armenia. Several causes of American waste in this particular can be mentioned. One is that when food was superabundant, that was not waste which is now wicked waste. It is not wasteful to feed potatoes to pigs when the supply is greater than the needs of all human beings who can be reached. We have in general left behind us the days of crude plenty, but have not changed our psychical make-up nor our habits to correspond with new economic conditions. Here the need is intellectual and moral education—a better vision and more altruism. We need a keener social consciousness and a new state sense if we are ever to solve the problems of conservation.

The individual is too frequently thoughtless and indifferent with respect to the future. Education of the intellect helps to a slight extent, because as men become more intellectual the future means more to them. Moral education helps still more, as it means precisely a strengthening of the other-regarding feelings as opposed to self-regarding impulses. It means more self-control and ability to sacrifice within rational limits the present for the future. Better government means that the future counts for more, as it is more certain. Better health and long life further decrease the premium which the future must pay for present sacrifices. Without adding further considerations we may generalize as follows: Every step forward in civilization means increased regard for the interests of the future.

But, on the other hand, we must acknowledge that enlightened self-interest has a greater rôle to play in conservation than is generally understood. When attention 15 years ago was called to the enormous waste of natural resources, the private owners began to think about the possibilities of profitable conservation, and they are still making investigations and improving methods. Great mining companies particularly may be mentioned as illustration, and naturally the owners of the fee in mining properties have shown a special concern. Real progress has thus been made; but the rate of interest sets a limit, as my colleague, Prof. Leith, has shown. Some ore companies have been obliged to recede in part (in part only, observe) from earlier conservation practices, because they found no prospect of getting interest on the investment involved in carrying saving so far as they were doing.

Large concerns are apt to be operated by far-seeing men, who acquire at times an interest of affection, so to speak, in these concerns, and they will be inclined to go as far as is practicable in conservation; as the country grows older, the interest rate is likely to fall, and other causes will favor an increasing degree of conservation, due to private initiative.

But there is a sharp limit to the economic sacrifice that we may reasonably and ethically ask the private person to make for even the present welfare, and

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the limit is still sharper when we come to consider the interests of future generations. *When it is possible, and as a general principle, social burdens should be socially diffused and socially borne.*

Let us consider some applications of the principle we have just formulated. We know now that it is one of the prime functions of the State (State used in the generic sense and including Federal Government as well as the separate Commonwealth) to raise the ethical level of competition by legislation and administration. Men may work 12 hours a day under the system of laissez faire and their employers may compete with each other. If by the State the number of hours is reduced to 8, the competition of employers may continue unchanged, save that it takes place on a higher ethical plane. Endless illustrations could be given, taken from Sunday work, child labor, sanitary conditions, etc. Now we may similarly establish a level of competition based on the principles of conservation. Practices which are not in accord with that level of conservation which we wish to establish may be prohibited. When we decide how carefully the coal should be mined and how much waste of natural resources in the exploitation of iron ore we are willing to tolerate as a maximum, we may prescribe methods giving the desired results, and we must bear the pain or burden in higher prices. Competition would not allow one individual to increase his costs greatly above those of his fellows, and so common action is a necessity.

The mention of competition suggests that unregulated and uncontrolled it is very generally speaking destructive alike of human and natural resources, and that it is a force which like the flow of rivers needs to be bridled and guided to produce socially beneficent results. Destructive competition can be prevented only by social efforts. Again, I must mention the work of President Van Hise in pointing out in his book, Concentration and Control—A Solution of Trust Problems in the United States (1912, revised edition 1914), the evils resulting from those "trust-busting" campaigns of politicians who advocate competition at all times and places and let loose upon us forces of destruction.

But as the principle of regularities in large numbers forms the basis of the vast business of insurance, it also furnishes a considerable scope for the activity of the State in the conservation of human natural resources. It is well known that individuals, especially among the wage-earners, are too willing to take risks to life and limb. Let us suppose the chance of becoming a helpless cripple in the course of a year is as 1 to 10,000; this seems so small that the individual is generally ready to overlook it, and neglects measures to remove the danger. But to society there is no chance, only certainty of this human loss, which in its ramifications is far greater than is at first apparent. It means 100 wrecked existences per million and 10,000 per annum in a population of one hundred millions. We have in this principle of regularities in large numbers a wide scope for society to promote conservation alike in its own interest and in the interest of the individual. The "Safety First" movement is one of many evidences of an awakening realization of possibilities in this direction.

As another illustration of the possibilities of altogether wholesome conservation which comes under this general head I mention the enormous destruction caused by fires in the United States. Public authority must compel those precautions which are alike in the interest of the individual and of society.

But we may look at this question from still another angle. Protectionism has often an educational value. When we prohibit certain practices which exhaust natural resources rapidly, it will often be found that through the pressure of legal force we shall be stirred out of a certain inertia of lethargy, and discover better methods which involve little or no increase in expense.



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But we find ourselves in a position when we shall frequently have to decide between private property and public property. The benefits of private property come in large part from the free initiative it allows the private property owner, and this is based on the hypothesis that in following his own initiative and knowing his own interest he is following a line of conduct which is in the interest of society. This is illustrated by the condition of the farmer, where we have a fairly satisfactory system of land tenure. The intelligent farmer in pursuing his own interest, in raising the best crops and animals at a minimum cost, is doing exactly what it is in the interest of society he should do. The case of our railways is the opposite, for we regulate these to such an extent as to remove from private property a large part of its satisfactions and its benefits. So if we are obliged to regulate very far private property in the interest of conservation, we have a strong ground for public property; as illustrated in the case of forests, and in this case public ownership is the world over gradually gaining on private ownership. Consideration of conservation then leads us to the following:

*The principle of guidance in changes from private to public property and from public to private property.*—Private property yields the best results when the social benefits of private property accrue:

(*a*) Largely spontaneously.

(*b*) When occasionally they are easily secured by slight applications of force.

(*c*) When the social benefits of private property are secured as the results of single public acts occurring at considerable intervals.

(*d*) Private property may yield excellent results, when in more or less frequent cases a continuous and considerable application of force may be needed to bring its management up to a socially established ethical level.

But in proportion as the social benefits desired are secured by increasingly intensive and increasingly frequent applications of public power, the advantages of private property become smaller as contrasted with the advantages of public property.[1]

We have, furthermore, a ground for passing over to public property when for the sake of the public welfare now or in the future a kind of use is exacted, involving a greater sacrifice of individual and corporate private interests than is warranted by the doctrine of the police power, as accepted at a particular place and time.

I can not go into all these points, but I am confident that the more you think about this statement of a general principle, the more far-reaching you will see that it is in its application to conservation. I want to say, however, just a word about the last clause, which relates to the police power. We hold all our private property subject to that; in other words, certain general sacrifices may be exacted of all in the general interest, relating to health, decency, etc., and this burden increases as time goes on; but when we must exact more than is in harmony with this limitation, known as the police power, we have a ground for public ownership.

No one is warranted in jumping to the conclusion that this principle means a suppression of private ownership of land and capital and of private initiative. On the one hand, our classification of natural resources shows that, so far as we can now see, they are mostly adapted to private ownership; we have also observed improved practices of private owners, rendering less urgent and less far-reaching the demands of public ownership; on the other hand, the growth of the police power in itself makes the field of public ownership narrower than it would be otherwise. Yet the general principle holds and

[1] See Ely's Property and Contract, Vol. I, p. 352, where an elucidation of this principle is given.

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no one can now foresee where the line will be drawn in the future. In the case of forests, the civilized world now recognizes a large amount of public ownership as necessary; so also with regard to the shores of harbors; so also with regard to mineral treasures, where there is general opposition to further alienation of the fee where it is now in public ownership.

Conservation then necessarily means more public ownership, more public business; this means a demand for better government; and this means giving men a real career in the public service.

It would require a small book—perhaps a large one—to elaborate the principles I have hastily sketched, and to fill in the gaps and complete the argument would certainly require a very big book. But I trust I have outlined the field for the economist in conservation.

*Commissions alone equal to the tasks of conservation.*—Now I will close with one very practical suggestion. It is only through a conservation commission or various conservation commissions—for several may be required—that we can put in force conservation. Legislation can never solve these complex problems, but can simply lay down the general principles, expressive of the will of the legislature; and in concrete cases the commission must make the application of principles, in other words, ascertain the will of the legislature. The commission must ascertain what is excessive present use and what is waste, must in concrete cases weigh over against each other present and future, must decide upon the burden to be imposed on private property under the police power, and upon compensation which is feasible and required; it must set limits to the sacrifices which may be legally and ethically exacted of the individual and the private corporation.[1] From time to time it will have to recommend the establishment of new principles by legislation; and the courts, as having the last word in social progress, will review certain decisions.

But the great burden must rest with commissions. And do not commissions give us the democratic solution of the complex economic problems of our day? The legislature lays down the principles, and if the commissions furnish men with careers, with honor, the public may command as well-trained capacity and as high talent as the greatest private corporations and for far less cost. Recognition, the development of democratic sources of honor, open careers to capacity and talent—all these will draw to the service of the people men who will be equal to the tasks of government, and who in their own persons will illustrate the nobility of social service and make men proud to say, "I am a civil servant."

## THE ECONOMIC BEARING OF FUTURE TRADING IN AGRICULTURAL COMMODITIES.

By HENRY C. EMERY.

There are many points of view from which the subject of future trading may be approached—the theoretical, the historical, the ethical, the practical. Fortunately for the speaker, he is limited by the character of this subsection of the Pan American Congress to the intensely practical. Our general subject is

[1] On the sense of social responsibility in its relation to conservation and the sacrifices to be enforced by law on the individual and the private corporation, see Van Hise: The Conservation of Natural Resources in the United States, pp. 362–368, 374–375, 377. I think President Van Hise exacts too much of the private individual.

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the "marketing and distribution of agricultural products." The relation of future trading on the exchanges to this problem is clear-cut and simple. There may be occasion for debate on the theoretical niceties of the real function of speculation. There may be still more occasion for difference of opinion as to whether the moral evils of an organized speculative market outweigh its economic advantages. But the proposition that organized future trading (in those articles which naturally permit of it) increases the efficiency of marketing is a proposition more easily proved than almost any other practical proposition in the whole field of economics. It can be shown historically, statistically, theoretically and practically. Indeed, it is not exaggeration to say that, partly because of it, the marketing and distribution of wheat is perhaps more efficient than that of any agricultural product. If one should ask what is meant by "efficiency" in this case the answer is that the phrase implies not only a prompt market for the producer under definitely known conditions and a prompt service under similar conditions to the buyer, but it means as well that the gap between the consumer's price and the producer's price (plus freight) is here reduced to the minimum.

Nevertheless, we find a widespread popular opinion that somehow speculation in futures is economically harmful and should be suppressed by law. I suppose our real problem to-day is whether the members of a scientific congress should support or oppose proposed legislation of this character. This feeling of antagonism to futures is owing partly to the general willingness to believe that one's own lack of prosperity is the result of malicious conspiracy, partly to the fact that as trade becomes more idealized it becomes harder to understand. The function of a baker is easier to understand than that of a banker; that of a janitor than that of a judge. In this particular case it also appears that the speculative market is continuously blamed for exactly opposite conditions—for high prices and for low prices. The producer thinks he would get more for his product without the speculator; the consumer frequently thinks he would pay less. This is true in extreme cases. In famine years the speculator helps to keep the price down, and in years of unusual plenty he helps to keep the price up. But the real fact is the exact opposite of the general assumption; that is, in the long run the speculative market secures higher prices to the producer and lower prices to the consumer than would otherwise be the case. This is what is meant by saying that it increases the efficiency of the marketing of agricultural products.

The method by which this result is brought about can best be understood by a consideration of the conditions under which a futures market is possible; for it is not true, as commonly supposed, that men can adopt and maintain this form of trading at will in any community. A few weeks ago I overheard a group of men discussing the development of a futures market for sugar since the outbreak of the war. It should be noted that while there has long been a lively speculative market for sugar in Europe there has been none in this country for a generation. To my question as to the reason for this new development, the answer was, "Oh, they just wanted one thing more to gamble in." This answer represents a common error as to the possibility of speculation in futures. It is not possible to establish such a speculative market simply at will. It is always the product of actual uncertainties of supply, demand, and price over an extended area of such a character that speculation arises as a natural method of handling these risks. Wherever the market conditions are local it is impossible; wherever the price is subject to substantial control by a single group, or two or three groups who may come to agreement, it is impossible Thus there used to be active speculation in petroleum till the Stand-

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ard Oil Trust became the dictator of the price. The same was true of sugar until the recent world changes in the matter of demand and supply.

Even where world-wide uncertainties, not subject to control, prevail a futures market is possible only in the case of a few commodities. These commodities must be *representative*, or, to use the language of the civil law, fungible (*res fungibiles*). This means that one portion is exactly like another portion. Money is the best example. I do not promise to pay 100 specific dollar bills, but simply 100 dollars, because one dollar is the same as another dollar. Securities of the same issue are another example. One stock certificate for 100 shares of Union Pacific is equivalent to any other certificate for a like amount. Where goods are not perfectly "representative" they can be made sufficiently so for trading purposes in a few cases by grading and classification. Thus wheat is classified into many different grades so that for trading purposes contracts can be made in general terms in some specific grade. No one would dream of buying simply 10,000 bushels "of wheat" without seeing the wheat or being sure of a fair sample, but one can buy 10,000 bushels of "No. 2 hard winter," or "No. 1 northern," and know what his contract means. The same is possible of a few other products, but of far fewer than most people realize. There is a constant demand for "standardizing" goods, but most agricultural products are not subject to any such standardization as is required for future trading. Thus some shippers establish grades of such high reputation in the case of, say, apples or potatoes that individual buyers will order by grade without even asking for samples. But this obviously is inadequate for a general futures market. This meeting is concerned only with "agricultural commodities." The absence of speculation in practically all manufactured articles is another question, but the reasons for it are fairly obvious.

The importance of this factor is easily understood when we realize the meaning of a "future contract." In its simplest form it is merely a contract for goods to be delivered and paid for at some future date. Such contracts are common enough in all business and arise from a variety of circumstances. The term, however, has now come to connote the inclusion in such dealings of sales made by sellers who do not at the time own such goods and who are not themselves producers contracting to deliver their own products when grown. That is, the system of "future trading" implies the activity of the speculative "short seller"—the speculator who trades "for the fall" as well as the speculator who "trades for the rise." Equal facilities to both is essential to a futures market. That is why the system of grading and classification is the very basis of commodity speculation, and that in turn is the reason why such speculation is limited to a few commodities.

The chief results of an organized speculative market are to be found in its effects, first on the risks of the ordinary merchants and manufacturers handling a given agricultural commodity and secondly on the prices received by the producer of the raw material and paid by the consumer of the finished product. Ours is the latter problem, but even it can not be fully understood without a recognition of the importance of "hedging." Assume, then, a speculative wheat market in full swing where "bull" and "bear" speculators, and merchants and millers as well, are daily active, with all the modern facilities for transferring, settling, and clearing contracts. This is a market where all the conditions of supply and demand the world over are known as far as human sagacity permits, and where at each moment of the trading day a price will be quoted for specified grades deliverable at various future dates. Here is a definite market with certain prices. No man can know to-day what the cash price of wheat will be in May, but you to-day can know at what price you

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can get your wheat in May, for some one stands ready to name a price this minute at which he will deliver you wheat during that month. He will take the risks of the ups and downs of price in the meantime. You can make your terms now.

It will be seen that the result of this is that merchants who buy of the farmer to sell to the miller or exporter, or millers who buy in order to grind flour can turn the risks of fluctuating prices onto the speculators. This is exactly what they do. When a Minneapolis miller buys wheat in Dakota, out of which he later intends to make flour to be shipped perhaps to Liverpool, he at once sells an equal amount of "futures" in Chicago or elsewhere. Under the old system, if by the time he is ready to sell his flour, both wheat and flour had fallen in price, he would have met with a substantial loss. Under the new system he is compensated by the profit he makes in "covering" on his hedging contract. Vice versa, of course, where a rise in price would formerly have meant a speculative profit for him, under the present system this profit goes to the speculator. He stands to make only his normal industrial profit and leaves speculative losses and gains to the speculator. The risks of fluctuating prices over a period of time have been shifted to other shoulders. Bear in mind this is not a fanciful picture. Practically the whole wheat and flour business of the country is carried on in this way.

You will see at once the bearing of this on our fundamental problem of relative prices to producers and consumers, which we took at the outset as a test of the efficiency of marketing methods. Before the speculative market had fully developed, the miller had to assume the speculative risk of falling prices which always exists anyway. He in turn tried to shift it onto some one else—either the producer of his raw material or the buyer of his finished product. What actually happened was that he usually paid the farmer from 5 to 10 cents a bushel less than the ruling price of the central market even after making allowance for transportation. To-day there is no such need and competition does not make it possible. The farmer at each point in the wheat belt gets the price of the central market, less only the cost of transportation and handling. This is because the miller or merchant can now afford to do this because he at once "hedges" in the speculative market.

What has become of that 10 cents that used to be deducted from the farm price? Either the farmer get it, while the purchaser of flour is paying no more than under the old system; or possibly he shares it in part with the consumer who buys a barrel of flour. In either case is there not a great gain in market efficiency? Everyone is familiar with the wide margin or "spread" which exists between the producer's price and the consumer's price in the case of many agricultural commodities. This is due to many different factors among which the most important are perishability, quantities in which the commodity is handled, difficulty of establishing standard grades, difficulty of storage, loading and shipment, relation of freight to total cost, as determined by the high or low value of the article per ton and the like. When we say that wheat and its products are delivered from the producer to the consumer with the greatest efficiency of any agricultural commodity it should not be supposed that the claim is made that this is solely due to the system of future trading. In the case of all the above factors save one, wheat has an advantage. It is durable; it can be easily graded, and it lends itself, through its "flowing quality" to unusually efficient methods of loading and unloading for purposes of storage or shipment. Only in the matter of the relation of freight rates to value is it at a disadvantage. Even some of the above advantages, however, in marketing this commodity would be lessened if it were not for the existence of the broad, open speculative market. The fact that it is

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always possible to get a quotation at which one can either receive or deliver the article at any specified time or place makes it possible for all parties engaged in the business to work on smaller margins because of the lessened risk. Also the existence of the futures market makes it easier to borrow money for carrying purposes at any stage in the process. Elevator receipts for wheat are the best collateral in the wheat belt. Finally that spread between producer and consumer which is necessary to cover risk is eliminated. This is simply the final and important result of the perfected system.

I have spoken of the difference in this regard before and after the adoption of future trading. The same thing can be shown between two such similar commodities as wheat and barley. There is no future trading of consequence in barley. Unlike wheat, it is not susceptible to classification of the same general validity as are the grades of wheat. This is partly due to the fact that different maltsters attach different values to the same barley because of quite peculiar needs for their special product. In any case, such a comparison seems to throw light. Prof. Weld, of Yale, has made careful calculations of the spread allowed for handling these commodities between the central market and farms at distances from 100 to 800 miles, including risk but not including freight. He shows the spread on barley to be from 1½ to 2 cents per bushel higher than for wheat. Now, a bushel of barley is only four-fifths of a bushel of wheat by weight, and over a period of 10 years the price of barley per bushel has been about 75 per cent of the price of wheat. This makes the difference in spread between the two from 4 to 6 cents per 100 pounds. Is it not fair to assume that a very considerable share of this difference is due to the absence of future trading in one case and its presence in another?

It is not possible to review in a short address experiments in legislation in this field. Reference must, however, be made to the most thorough stoppage of future trading in grain ever effected—namely, under the German exchange act of 1897. That was carried through by agrarian influence against the recommendation of the great commission of 1896. The result of this prohibition was that there was no longer any open market where the farmer could tell at once the price of his wheat or rye. The merchant and miller could no longer tell with certainty what they could afford to pay. Promptly a demand was made on the Government for the establishment of central price bureaus. Obviously, however, these could not supply the deficiency. They could tell an inquirer what grain sold at last week, but his real need was an answer to the question, "What is my product selling for now?" Unless the merchant and miller could hedge in foreign markets, they were obliged to assume their own risks, and for this additional burden producer or consumer had to pay. Furthermore, the abolition of futures carried with it a necessary return to much more cumbersome methods of trading, of settling and clearing contracts, and also reduced credit facilities for all concerned. For all this somebody had to pay. It is safe to say that the producer got less for his raw material and the consumer paid more for his finished product than before. This is exactly what we are all trying to avoid. It is a good example of what efficiency in marketing is not.

All these allied factors must be kept in mind. It is not merely the futures market in its direct effect we need to consider, but the futures market as the flywheel on the whole wonderful mechanism of trade and credit by which agricultural products are carried across the world from the producer to the consumer with a promptness and cheapness truly marvelous. There may be other arguments of a different nature against this method of trading. So far as the question of efficient marketing of farm products is concerned, which is the subject of this conference, the case is proved.

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## CONSERVATION IN ITS RELATION TO INDUSTRIAL EVOLUTION.

By RALPH HENRY HESS,

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The portrayal of "economic stages" constituting the industrial progress of mankind is a customary and useful pedagogical device of political economy. In the description of these industrial areas, economic writers assume the existence of a relative abundance of soils and other natural resources during the earlier "pastoral" and "agricultural" stages, and reverse conditions of dense population and intensive utilization of natural resources during the later commercial and manufacturing stages of evolution. The succession of economic activities from the simple tasks of appropriating the free goods of nature to the complex processes of modern production is generally taken as a manifestation of the evolutionary principle of man's adaptability to his environment. But in this consideration of evolutionary tendencies there is little if any analysis of the changes which take place in the relative importance of the material agents of production which serve the needs of society. Nor do we find much thought given to the interpretation of man's conscious adaptation of his environment to his needs. It is the present purpose of the author to very briefly indicate certain evolutionary aspects of industrial conditions which are reflected in changing relative values of economic factors. In view of such changes it is maintained that conservation policies, if successful, must recognize the transitional character of industrial values and be constructively flexible and evolutionary.

### THE EVOLUTIONARY RELATIONS OF NATURAL RESOURCES, POPULATION, AND CAPITAL.

That there are substantial quantitative variations in industrially employed natural resources, labor power, and capital which are evolutionary, and become apparent with social progress and the flight of time, is obvious. Simultaneous changes in social values, or in the relative importance of these industrial elements to society, may be less objective than are their quantitative changes, but they are equally real. A chronological view of the changing relative values of the factors of industry and production is the first essential in the formulation of conservation theories and policies. Whatsoever of virtue there may be in conservation as a public policy must certainly be consistent with the evolutionary facts of economic life.

An examination of the possibilities of conservation as an economic principle involves recognition of a variety of social philosophies which constitute effective forces of social control. Individualism, sectionalism, nationalism, and cosmopolitanism present different and mutually contradictory ideals of economic life and hypotheses of public policy. The intellectual acceptance by individuals of a conservation policy—define its motives, methods, and consequent economic adjustments as we may—will be directly proportional to their several personal anticipations of benfits to follow its application. That the conceptions of social value entertained by persons and groups of persons, ranging in their social philosophies from individualism to cosmopolitanism, will be in agreement as to the probable benefits of any form or degree of conservation, is extremely doubtful. Indeed, a review of conservation literature must convince one that a generally acceptable definition of the term has not been even approximated. We are, therefore, forced to proceed upon the hypothesis that any useful description of the possibilities of conservation must acknowledge a definite pur-

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pose and a variety of circumstances rather than conform to a standard concept of "conservation" as a doctrine or policy. This purpose, as the author sees it, will appear shortly.

Circumstances which are of consideration in outlining the possibilities of conservation include—

First. The physical order of industrial evolution and the changing relations of natural resources to other agents of production, and to economic needs as they develop.

Second. The doctrines of social philosophy which sanction prevailing economic institutions, and such change or trend of these habits of thought as may be anticipated of the future.

Of these two sets of conditions characterizing industrial society, both are evolutionary. The first pertains to the material facts of human existence and environment, viz, increasing density of populations, changing availability and efficiency of productive forces, lessening economic opportunity, and consequent readjustments of industrial organization. The second set of conditions to be considered in the formulation of conservation policy pertains to psychic facts of human relations, particularly relations growing out of the possession, use, and enjoyment of natural resources, viz, economic and social rights and responsibilities and the definition of governmental authority in relation thereto.

SOCIAL VALUE AND PRODUCTION POWER.—Observation and analysis of the changing social significance of acres of land, hours of labor, and dollars of capital are not new to political economy. The Malthusian teaching that, as time goes on, the ratio of land to population grows less favorable, when considered from the social point of view, is an accepted major premise in the formulation of labor, land, and immigration policies. Ricardo's analysis of the natural distribution of labor and capital among lands of varying fertility and his observation that, as population expands, poorer and poorer lands come into cultivation revealed the fundamental forces which determine land rents. A combination and elaboration of the Malthusian doctrine of population and the Ricardian theory of rent constitutes the foundation of modern economic theory of distribution of wealth and, in considerable measure, of public policy upon matters of wealth and income in so far as it is in accord with scientific demands. These theories, moreover, furnish us with grounds for a logical defense of private property and private income, and bases for the regulation of property and income in accordance with changing social conditions.

Conservation is obviously concerned with social values and productive power. It is concerned with the functions of natural resources, labor, and capital, and their relations one to another, and particularly with their future pecuniary probabilities and potentialities as contrasted with actualities of past and present. Proceeding in accordance with these principles, conservation may be characterized as a socially prudential economic policy directing a providential administration of the natural agents of production and enforcing reasonable restraint in the consumption of the physical resources of the earth and, when possible, promoting their development, to the end that (1) productive capacity may be developed and maintained, and (2) the natural inheritance of the race shall not be unreasonably impaired.

An analysis of industrial evolution adequate to afford either an historical or theoretical background of a comprehensive conservation policy will necessarily deal with the changing aspects of the different factors of production. These are revealed in the shifting rôle of natural resources as industrial society evolves from the primative environs of the frontier toward a permanent state

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of economic maturity, or until industrial organization and coordinated public policy, failing of ultimate achievement, shall pay, by economic regression, the penalty of inefficient government.

THE FOUR STAGES OF INDUSTRIALIZATION.—There is a normal order of change in the inter-relations of natural resources, labor power, and capital in the course of industrial progress. The necessary economic readjustments which appear among these agencies of social production are so marked as to separate the industrial evolution of any community into four possible stages or chronological periods which may be indicated as follows:[1]

1. A period of exploitation.
2. A period of industrial development.
3. A period of industrial maturity.
4. A period of industrial regression.

*A period of exploitation* is characterized by the proprietory occupation of natural resources in a new country and the initial application of labor and capital in the industrial processes of wresting wealth from the new land. The pecuniary needs of those directly interested in such industry, be they promoters, settlers, or laborers, are usually immediate, and the rewards of their enterprise must be realized in quick profits and present values.

The industrial occupation of new regions is frequently favored by the existence of a considerable fruitage of natural goods and commercial values found ready for the gathering. Indeed, a foreknowledge of such profits of exploitation is the usual incentive of frontier occupation. Natural resources are abundant and cheap and, in the absence of official restraint, wild fur-bearing and food animals are taken, placer gold and other surface deposits of the minerals are exhausted, forests are leveled, natural pastures are denuded, and soils are impaired. This is exploitation[2]—the destructive appropriation of natural resources for the satisfaction of immediate human desires. Such wants may be a matter of contemporary sustenance for pioneer populations; they may contemplate means of securing the additional labor and capital essential to succeeding stages of industrial growth; or they may exemplify a craving for hasty accumulation of private fortune regardless of present social needs and without thought of future industrial prosperity. Exploitation is frequently preceded by a considerable speculative outlay of capital. Such outlays are quite necessary to make available the resources in question, and, because of the assumption of extraordinary risk, may entitle investors to "speculators' profits" in cases of successful ventures.

The ultimate significance of exploitation to the conservationist lies, not so much in the fact of a harvest without sowing or in the using up of easily accessible resources, as in the possible effect of the ruthless heel of the careless harvester upon the virility of latent and undeveloped natural agents of future productivity and of consequent social values.

*A régime of development* follows after the hand-to-mouth scramble of the frontier. Having exploited the naturally matured values of the land, mankind

[1] Not all communities may experience all of these industrial periods. The regressive period may usually be avoided by the exercise of prudential economic policies. On the other hand, social and political conditions may be such as to invite regression in lieu of industrial development and maturity.

[2] "Exploitation" is here used to indicate that destructive utilization of natural resources typical of initial industry; such resources being consumed, or marketed in exchange for consumption goods with a minimum expenditure of labor, capital, and time. The term also includes the destructive conversion of industrial capacity into present wealth and the using up of nonreplaceable resources during later periods of industrial evolution.

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ceases to reap where nature alone has sown, and, for the time, devotes itself to sowing and cultivation that there may be other harvests. In order that industrial production and commercial values may be realized in the future, labor, capital, and managerial ability are poured into the mines, spread upon refractory soils, winrowed along transportation routes, and pyramided at manufacturing and commercial centers. In brief, exploitative acquisition is displaced by production and transient undertakings give way to permanent industry. A tedious and hazardous period of labor and capital expenditure, usually in excess of concurrent industrial revenues, is necessary to the establishment of an efficient and permanently productive mechanism. This succession of exploitation and development is inevitable, whether consideration be confined to a single private enterprise, or extended to State-wide, Nation-wide, or world-wide economic activities.

The chief characteristics of the developmental stage of industry, as compared with the exploitative period, are:

1. The increasing proportion in which labor and capital are combined with natural resources involved in industrial processes.

2. The establishment of permanent instead of temporary economic and social institutions.

3. The conscious social effort to put production upon a definite annuity basis.

The aim of industrial development is the utilization of natural resources under efficient and mature organization. Such organization involves a coordination of the several factors of production which affords not only the mutually profitable employment of labor and capital, as in the exploitative period, but a socially expedient and prudent utilization of natural resources.

It should be observed that, no matter how rich natural resources available for a specific industrial enterprise may be, substantial development generally requires an excess of expenditures over earnings for a considerable period. Development becomes possible, therefore, by virtue of a present sacrifice of capital and labor, the remuneration for which must await the maturity and possible success of the venture. The earlier profits of exploitation are not infrequently the source of capital which is later employed in industrial development. Likewise, the natural increase of the population and the flow of immigration which supply the necessary labor power of development very generally find their economic origin or stimuli within the régime of exploitation.

The economic history of the United States and Canada—in fact, of all American States—abundantly illustrates the dependence of industrial development upon the pecuniary surplus and the population growth consequent to a successful exploitation of natural resources.[1]

Our pioneer existence not only was conditioned upon a using-up of resources which, to some seems regrettable, but our present social capital is mainly the proceeds of a favorable trade balance from the export of raw products of exploitative industry. Our foreign credit, until recently an essential source of developmental capital, has been based upon the anticipation of a continuing export of products in the origin of which exploitation plays an important rôle.

*A period of industrial maturity* is reached when a community becomes permanently self-supporting; that is to say, when, in so far as may be foreseen,

[1] The customary reliance upon the profits of exploitation, as a source of capital for development, is revealed in the absence of private initiative and the consequent necessity of governmental development where rewards of exploitation are not inviting—the Panama Canal; the United States Reclamation Service; the construction of railways in northwestern Canada.

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the productive capacity of the industrial combination of natural resources, labor, and capital will continue adequate to meet the needs of the population without substantial impairment either of resources, capital, population, or scale of living. Industrial maturity does not necessarily imply maximum economic efficiency, or an intensive industrial organization, or even a stable population. The concept embraces a variety of conditions of personal, community, national, and cosmopolitan self-sufficiency. In the growth of most industries, or industrial communities, or industrial nations, development normally merges into economic maturity which, at first, involves an extensive utilization of natural resources and gradually advances toward intensive utilization. The maximum degree of intensivity will, however, finally be determined by sociological factors and prevailing standards of social saturation.

The idea of permanence, as applied to social and economic policies, is not absolute. Industrial permanence can imply no greater futurity than is contemplated by the impelling social interests of the present. Such interests are, as a rule, probably satisfied with a shorter look into the future than is commonly supposed.

*Industrial regression* is evidenced by a declining ratio of industrial productivity and social income to economic effort.[1] Despite a dominating popular desire to attain and maintain the highest level of productive efficiency, average income, and social benefits in every industry and in every community or nation, unforeseen defects in economic policy, in industrial structure, or in social adjustments seem finally and invariably to invite economic degeneracy. Historically, regression seems frequently to follow close upon the attainment of an advanced state of industrial maturity; closer, in fact, than has generally been realized, for a semblance of prosperity is usually sustained for a time in the effort to disguise weakening industrial capacity.

Logical as is the concept of economic equilibrium, its existence is, in the main, confined to the vision of doctrinaires. Nevertheless, if industrial regression is to be forestalled, a conservation policy of positive and preventive measures is imperative; and such a policy cannot ignore the desirability and, indeed, the possibility of a state of approximate economic equilibrium.

Customary practices of exploitation and industrial development, doubtless, tend to weaken the foundation of economic permanency. Overexploitation of certain natural resources has undoubtedly dwarfed the industrial powers of many communities and of some nations. The over-hasty development of certain forms of production in the United States accounts for some clearly discernible symptoms of regression. Likewise, the economic aspects of importing cheap labor to hasten development are quite as disconcerting to prospects of a high level of economic equilibrium as is the physical impairment of natural resources.

It is to be observed that the successive stages of exploitation, development, maturity, and regression are not always clearly separable in the industrial life of a community or a nation, or even in the industrialization of given classes of natural resources. In this, as in other analyses of social phenomena, generic terms are typical rather than mutually exclusive in their appellation. The nature of the resources themselves may justify coincident exploitation of some and development of others—possibly, as I have already suggested, the cost of developing the one is borne by the gain of exploiting the other. Furthermore, what is generally designated as over-hasty, under-capitalized, and prodigal

[1] In private industrial enterprise, regression is evidenced by declining profits.

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development may be akin to reasonable exploitation; the alleged haste, waste, and inadequate capital being, in fact, the best possible or most expedient adjustment of available industrial resources to the immediate needs and conditions of society.

The uncertainty of population growth during early industrial periods, and of potential social scales of consumption, particularly in the absence of a definite immigration policy, makes an accurate forecast of the results of any industrial policy difficult. Certainly, restrained utilization and conservative development are not always to be recommended. The probabilities of undiscovered deposits of natural resources, undiscovered uses for those now available, undiscovered methods of utilizing resources now superabundant, and undiscovered or undeveloped substitutes for resources now being exhausted make an intelligent choice between exhaustive exploitation and conservative development, at best, uncertain.

RATIONAL SOCIAL POLICY AND THE CHANGING ORDER.—If we consider the relativity of the factors of production during the periods of exploitation, development, and maturity, and especially the quantitative relations of natural resources to labor, a changing order of their importance is strikingly noticeable. A scanty population and a surfeit of natural resources in the beginning is in marked contrast with a dense population and overmanned physical resources at the other extreme of the evolutionary scale. The keen need for capital during the period of development and its subsequent increase in amount and availability are likewise significant. Indeed, the ruthless disregard of human agencies of production and a repletion of capital at the subsequent extreme of industrial evolution is as logically patent as is the exploitation of the seeming surfeit of natural resources in the beginning. The economic history of Egypt, China, Poland, Italy, and Spain supplies examples of what might be called exploitation of humanity and capital.

To say that industry requires the cooperative action of all the factors of production is commonplace; but the fact that, within limits, land, labor, and capital are mutually compensatory in the composition of the industrial mechanism of the nation has received little or no comment in the discussion of conservation. The organization of industry and the formation of economic policy must have regard for the changing relative values of the component factors of national production. The principles of value and the law of demand and supply equally apply to the valuation of the creative agents of industry and to the products of industry.

A universal phenomenon of industrial evolution is the contrast of steadily advancing values of natural resources and declining or regressing values of labor and capital. During the decade last past arable lands in the United States have probably advanced in value 10 per cent annually, wages have accelerated at less than half that rate, and interest on capital has advanced even less, if at all. The result is not only an increase in land values but a growing physical proportion of labor and capital in the industrial unit. In other words, in passing from the extractive and extensive processes of exploitation and development to the elaborative and intensive process of mature industry, labor and capital tend to assume their normal or balanced proportions in the industrial mechanism, thus gradually compensating the frontier prodigality of natural resources.

In the earlier industrial stages the scarcity of labor and capital usually justifies extensive methods of industry and a proportionately liberal utilization of accessible resources which in a later stage would be truly wasteful. Conversely, with the approach of social saturation, human life and energy become

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plentiful, even superabundant, and the natural sources of subsistence become relatively scarce and consequently dear.

Thus, we observe the normal chronological aspects of extensive and intensive industry, and the rational adjustment of human and natural resources in either period must appear uneconomic and wasteful when judged by the standards of the other. Again, the necessity for developmental capital, in the absence of other sources of ready funds, frequently justifies a sacrifice of original resources by way of exploitation which to the casual observer, who is accustomed to the financial adjustments of mature industry, appears grossly destructive and wasteful. Conversely and with equal logic, the maintenance of economic opportunity and national integrity, essential to industrial capacity and social well-being, may require in the latter stage a temporary expenditure of life and treasure which, considered in the abstract, is barbarous and wasteful. This we may observe in its extreme form in certain economic causes and effects of war.

In the final analysis these facts emerge: (1) The evolution of industry usually implies a gradually reversing quantitative proportion and valuation of natural resources to labor and capital; (2) the overzealous fostering of any one factor of production involves a compensatory sacrifice or misuse of another; (3) mere quantitative measures of superficially apparent industrial prodigality, either of natural resources, capital, or humanity, are not always criteria of economic waste.

A policy which unnecessarily delays the natural expansion of population and industrial development by restricting the conversion of natural resources into capital during a frontier régime is social obstruction and false economy, not conservation. The restriction of opportunity for the normal employment of labor and the investment of capital by withholding resources from development is monopoly and industrial restraint, not conservation. Socially considered, such practices constitute the essence of economic waste and of industrial inefficiency.

The social ideal of industrial maturity is a continuing economic progress until a comfortable scale of community or national living is attained, and thereafter the maintenance at least of this standard of industrial capacity and social well-being; and this ideal does not imply a stable population, a fixed standard of living, or the nonimpairment of natural resources. It does mean, however, a rational adjustment of population to physical productive capacity and a prudential protection of productive capcity in behalf of the calculable needs of the future, in so far as they may be shown to be socially superior to competing present wants.

The economic life of a nation, in so far as it may be directed by conscious social policy or ethical considerations, must normally tend toward an efficient coordination of natural resources, population, and capital in production and in anticipation of future production. This principle is not new. The German economists have taught it for a half century. Daniel Raymond, an American, writing nearly a century ago, dwelt upon the thesis that capacity, not riches, constitutes national wealth.[1]

Raymond insisted upon the character of the nation as an economic unit. The interests of individuals or classes, he maintained, are not to be mistaken for the needs of the nation, for they may be opposed to the larger and continuing needs of the nation as one and indivisible. From these principles Raymond con-

[1] Raymond, Daniel: Thoughts on Political Economy, 4th ed., pp. 81, 84, 116, et seq.

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cluded that economic science may not properly be confined to the creation of values and the acquisition of riches, but includes, as its primary object, the development of capacity and of administrative and legislative means of securing the greatest well-being of all citizens, present and future, alike. Friedrich List, a German, writing under the stimulus of observations in America, a few years later than Raymond, likewise characterized the ideal of industrial enterprise: "The causes of wealth," said List, "are something totally different from wealth itself. The power of producing wealth is infinitely more important than wealth itself. The nation derives its productive power from the mental and physical powers of the individuals, from their social, municipal, and political conditions and institutions, from the natural resources placed at its disposal or from the instruments[1] it possesses."[2]

SOME HYPOTHESES OF CONSERVATION.—Before proceeding to an analysis of the practicability of conservation within the different stages of industrial evolution, a classification of natural resources and a restatement, by way of hypothesis, of certain physical and functional aspects of natural resources, here and elsewhere developed,[3] is necessary.

For purposes of economic analysis, natural resources may be classified as follows:

I. Resources which are so abundant as to have negligible present value, but bear promise of future scarcity, and value.

II. Resources which have present value and are subject to increasing scarcity, or demand—

1. Not exhaustible by use.
2. Exhaustible in use but subject to maintenance and restoration.
3. Exhaustible in use and not restorable.

III. Resources which have present value, but are subject to deterioration or loss of value through nonuse.

IV. Resources which have no present use or value, but which are subject to "reclamation."

Natural resources are but one of three essential economic supports of industrial society. Excepting conditions of extreme extensive or intensive industrial organization, land, labor, and capital are mutually interchangeable and compensatory in productive processes. The economic importance, or value, of a unit of either in terms of another is, at any time, inversely proportional to the relative supply.

Labor and capital, employed in private industry in conjunction with natural resources, require compensation to the extent at least, of subsistence and maintenance; otherwise, labor or capital is being exploited in behalf of natural resources.

Capital, socially considered, is a combination of transformed natural elements and "saved labor." It is possible that capital may incorporate greater and more enduring social values than would the uncombined natural resources and labor consumed in its creation.

There is a clear distinction between the methods and motives of private economics on the one hand, and the purposes and responsibilities incident to the practice of social economies on the other.

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[1] "Instruments" is here used by List to indicate industrial plant or capital.

[2] List, Friedrich: The National System of Political Economy, pp. 108, 109. Translation by S. S. Lloyd, 1904.

[3] Hess, R. H. Some Economic Aspects of Conservation: Eighth International Congress of Applied Chemistry, Vol. XXVI, p. 711.

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The costs or sacrifices involved in any conservation program are mainly present, direct and personal; the benefits which may accrue from such present sacrifice of labor, capital, or opportunity are mainly social, and are uncertain as to futurity, amount, and distribution.

That paradox of political economy which makes industrial capacity and abundant production the criteria of social well-being, and makes scarcity and restricted industrial output conditions of high values and private wealth, reveals the crux of the problem of formulating national economic policies.

Conservation involves the arbitration of conflicting principles of private and social economics. This is especially manifest under prevailing Anglo-Saxon institutions of property and contract.

The final arbiter is official authority asserted in behalf of the sovereignty of the state and the perpetuity of society and made effective through the arm of the police power in restraining the destructive exercise of individual freedom and restricting the unsocial use of property.

THE POSSIBILITIES OF CONSERVATION.—At times of economic and social beginnings, private initiative and individual needs are seldom in serious conflict with social progress, nor are present interests necessarily destructive of future welfare. Institutions of the future are certainly as dependent upon the perseverance of society as they are upon an unimpaired physical condition of natural resources. And when a temporary, or even permanent, impairment of natural resources, which may later be compensated for by an increased capital and improved labor supply, creates a greater industrial opportunity with a reasonable promise of permanence, the exploitative sacrifice may be highly justified. During such times of normal exploitation, therefore, a conservation program logically can go little farther than (1) to restrain the reckless destruction of resources having no considerable present worth, but subject to future scarcity and value, and (2) to restrict speculation by which possibilities of such future social values may be reduced to present private gain. Two regulatory provisions will accomplish these ends: (*a*) Education of the public as to economic needs of the future and the probable social values of resources now subject to destruction and neglect because of their negligible present value; (*b*) the establishing of the principles of "beneficial use" and "resource" valuation and taxation as sanctions of private property in natural resources.

The aim of development, except when very scarce and nonrestorable resources are involved, is to create a permanently efficient industrial organization of natural resources, labor, and capital. Permanent is, however, a relative term, especially when it is used in reference to private and to social institutions. What we may call the life interest of the individual is, of course, short in comparison with the interests of society or the anticipated life of the State. Therefore the social interest may dictate a more substantial and perhaps less hasty development or construction of industrial institutions than may be effected by private initiative. Here, again, a logical conservation policy may so direct the utilization of natural resources, particularly those which bid fair to become social necessities, as to make for industrial perpetuity rather than transient productive efficiency. "Haste makes waste" is an ancient proverb which is particularly applicable to the development of industry. When socially important natural resources are involved, conservation policy should adjust developmental methods to the attainment of the highest industrial capacity consistent with national security and social permanence.

The principles of conservation essential to wise development are complex and frequently their application is in discord with the traditional privileges of private property. In brief, they should include—

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(*a*) The gradual adaptation of natural resources to their highest use—"use" being interpreted in terms of social benefits rather than private gain.

(*b*) Restoration of partially exhausted resources when possible and socially expedient.

(*c*) Prudential utilization of exhaustible and nonrestorable resources, and the substitution of less exhaustible resources whenever possible.

(*d*) The reclamation of impotent resources by irrigation, drainage, etc., whenever socially expedient.

To put such policies into effect requires a considerable application of public authority and an extension of administrative functions beyond the sphere of *laissez faire* government. An official classification of natural resources, a mandatory supervision of uses of privately-owned resources, the maintenance or establishing of public property in the more exhaustible and highly essential resources, and the enlistment of official initiative and public finance in reclamation, compose the essentials of a conservation program fitted to the stage of industrial development. All of these practices are now legally sanctioned, although effective within a very limited range. Their rapid extension is a matter of social expedience, but such extension can only be through a reduction of the absolutism of private property and of the sphere of private contract, and with the aid of a temporary increase in the public budget, both State and Federal.

The stage of industrial maturity has already been reached in many industries and probably by the majority of nations. Under such conditions the ideal of economic progress is the maintenance of productive stability by the prevention of industrial deterioration and the wholesome restriction of social demands. A continuation of the conservation principles of development with an extension of the requirements for maintenance, restoration, and substitution, exhausts the possibilities of conservation in so far as public policy may be directed toward the official management of natural resources. If time were sufficient, we might, at this point, profitably inquire concerning the possibilities of conservation as applied to the accumulation and use of capital and to the efficient utilization of the productive power of the population; and, particularly, with regard to the sumptuary demands and the economic impotence of certain classes of society. This phase of the subject must, in the economy of time, be deferred.

*The regressive stage*, as above described, implies conditions of virtual industrial insolvency. Such conditions may result from either of the following causes:

(1) Exhaustion of nonreplaceable resources, such as mineral deposits.

(2) Exploitative impairment and neglect of resources which are properly subject to sustained industrial service; for example, soils, forests, and fisheries.

(3) Mismanagement in development, usually due to short-sighted private policy; for example, water-power promotion and public-land policy.

(4) Overpopulation resulting in failure of productive capacity to keep pace with economic needs of society.

(5) Overconsumption, due to an inequitable distribution of wealth and income and resulting in impoverishment of society and reduction of productive capacity by the indolence and sumptuary demands of the rich.

A conservation program fitted to the needs of industrial and social regression may very properly follow the business practices obtaining in wise receivership, namely, "close out the enterprise" or "reduce fixed charges and reorganize under an efficient management." Indeed, conservation, in its derivative meaning, does not quite apply to the processes of rehabilitation which are necessary to block industrial regression. Reclamation is a better term.



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In some industries or communities the appearance of regressive conditions leaves no choice but the abandonment of worked-out or permanently impaired natural resources in order that labor and capital may be economized. The resulting geographical or occupational migration of population and industry introduces no serious economic problem if undeveloped resources are elsewhere available or if new industrial opportunities may be conveniently substituted. The exhaustion of New England soils, Rocky Mountain placers, and Illinois forests were only temporary symptoms of industrial regression and were quickly corrected by readjustments of the population and changes of occupation.

Regression resulting from mismanaged development of natural resources may usually be remedied by the application of reclamation measures. Reclamation requires a considerable expenditure of labor and capital in order to relieve the productive capacity of natural resources. It is possible that a mandatory official supervision of industry may stimulate reclamation measures by private agencies. Much may be done toward preventing industrial regression by the requirement of depreciation, replacement, and amortization funds. However, experience has fairly well demonstrated that the public purse must bear the main burden of industrial reorganization and rehabilitation. Private initiative remains impotent in this field for the same reasons that apply to expensive and long-time developmental projects.

The Departments of Soils and of Forests, under the German Government, supply a working example of governmental reclamation of impaired natural resources. Other governments are rapidly following the example of Germany.

Overpopulation and overconsumption constantly menace the economic prosperity which should accompany industrial maturity. Prosperity in itself is a stimulus to population growth, and the physical limits which nature has placed upon industrial opportunity undoubtedly validate the principal theme of the Malthusian doctrine that population tends to overrun the means of subsistence. We are not yet seriously facing this problem in the United States. Nevertheless, the experiences of other nations are prophetic of our future.

Colonization and migration were the favored correctives for overpopulation in times past. Their present and future inefficacy is obvious. "Internal development" and commercial expansion have been attempted by Germany; with what ultimate success is not certain. Japan, with a population of over one-third that of the United States confined to an area equivalent to that of Montana, appears to be forced by the pressure of population to a policy of national aggrandizement. All other considerations aside, the economic and political effects of overpopulation justify serious inquiry and reflection upon the sources, elements, and conditions of population growth as a conservation measure.

Overconsumption in the United States is perhaps the most immediate obstacle to the advance, indeed to the maintenance, of the state of social and national well-being. A distribution of the pecuniary benefits of industry which places perhaps one-half the wealth and income in the hands of the more fortunate 10 per cent of the population, and only one-tenth of the wealth and income in the possession of the less fortunate 50 per cent of the population, is not conducive to national thrift. Three statements will here suffice to align the facts of wealth accumulation and extravagant living with the principles of conservation and social welfare.

(1) When great aggregations of wealth are arbitrarily, or by unwise management, withdrawn from reasonably productive industry, the capital of the nation is being impaired.

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(2) When the possession of private fortunes induces indolence and extravagance in such measure as to reduce the effective productive capacity of the population, or to divert industrial agents from the production of social necessities and comforts to the production of luxuries, both the natural and the human resources of the nation are being sapped and unreasonably exploited.

(3) The false ideals of success and the wasteful conventional scales of living induced by suggestion and imitation are far more injurious to the social welfare than is the prodigality of indolence and wealth, by itself considered.

A brief conclusion may here be drawn from the discussion of economic principles as developed up to this point.

Tentatively, at least, a comprehensive conservation program must regard—

(1) The state of economic conditions, particularly with reference to the quantitative relations of natural resources to other factors of production and to the density of the population.

(2) The evolutionary nature of society and the resulting chronological changes in all elements which enter into or are affected by conservation policies.

(3) The established economic, legal, and political institutions which describe and limit the use and control of natural resources.

(4) The technical structure and operation of governmental machinery necessary to administer the proposed conservation measures.

It is obvious that in pursuing such motives, enlightened self interest and authoritative pressure are properly first directed toward the correction of sociological conditions rather than to the business management of economic agencies. It is clear that political and governmental institutions should be strengthened by a further development of the police power, or "general-welfare authority;" thereafter the productive efficiency of business organization may successfully be improved; finally, the industrial efficiency of the population should be augmented by a progressive system of education, the systematic reduction of unemployment and indolence—including unprofitable leisure—and, possibly, the authoritative exercise of a wholesome restraint upon prodigal consumption and ultra-scales of living.

Adjournment.

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## SECOND GENERAL SESSION OF SECTION III.[1]

. RALEIGH HOTEL,
*Tuesday afternoon, December 28, 1915.*

Chairman, DAVID FAIRCHILD.

The session was called to order at 2.30 o'clock by the chairman.

Papers presented:

A forest policy for a nation, by Henry S. Graves.

The people's interest in water-power resources, by George Otis Smith.

Relation of the Government to the marketing problem, by Beverly T. Galloway.

### A FOREST POLICY FOR A NATION.

By HENRY S. GRAVES,
*Chief Forester, Forest Service, United States Department of Agriculture.*

A nation is fortunate which has abundant forests. A nation is wise which has the foresight to conserve its forests and to guard against the public injuries that always follow their destruction. Most nations have had to learn their lesson in forestry from experience and have not attended to the proper care of the forest resources until forced to do so by disastrous consequences of their wrong handling. The United States has been no exception to this general rule. No nation was ever more bountifully blessed with splendid forests than the United States; no nation has ever in history been more improvidently wasteful of them. We are now, however, in a new era. A new and enlightened public sentiment now exists relative to our natural resources, brought about by the reaction against the abuses of former years. Having without heed made the same mistakes as many other countries, having reached the same conclusions as to the principles of handling forests, we are now endeavoring to treat what we have left with intelligence and, so far as possible, to prevent further public injuries.

The other nations of North, Central, and South America are also naturally endowed with extensive and valuable forests. Canada has already gone far to develop a forest policy and has advanced shoulder to shoulder with the United States. In most of the other countries forest conservation has not occupied as much attention as other more urgent internal problems. In the near future all

[1] There was no stenographic report of this meeting.



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countries of the Americas will, I hope, have inaugurated a policy of forest conservation. In the development of such public policies the experience of this country should be of value.

The development of forestry in the United States is intimately related to the Nation's public-land policy. Many of the abuses in handling timberlands that are coming now more and more to plague the country were due to mistakes in handling the public lands owned by the Nation or by the States. An intelligent forest policy was made possible only when the Federal Government sharply reversed its former policy of disposing of the public forests, by itself assuming complete control and development of them.

Perhaps the most significant fact in the history of the United States has been the existence of a vast public domain, rich in every resource, favored by temperate and healthful climate, and owned in common by the whole Nation. Our history has been the history of expansion over this domain, conquering the difficulties of the frontier, peopling the great agricultural valleys and plains, building industries to utilize the abundant natural resources, and constructing great transportation systems to distribute the products of the farms, mines, and forests. The vast resources from these lands have been the basis of our great wealth. The conditions surrounding the development of the public domain have had a profound influence on the development of the Nation, on governmental institutions, on national policies of government, on the character of our citizenship itself.

The keynote of our public-land policy has been homestead settlement. The Government has aimed to distribute the public lands in small tracts to individual home builders. From the beginning the thought of large land holding with its system of landlord and tenant has been abhorrent to our people. The purpose was to people the public lands with millions of free holders. This policy was expressed in the free homestead law, which enabled any citizen of the United States to acquire land not to exceed 160 acres, provided that in good faith he established his home upon it and cultivated the soil. It was a splendid ideal, and the law was in the main successful, in spite of many abuses of it. It has been the greatest factor in the rapid building up of the great West. More important still, it has been the greatest incentive to developing among our citizens the individual initiative and self-reliance that are among the most conspicuous of American traits. Under such conditions were founded the ideals of democracy, communities of freeholders, free, independent, equal, self-reliant, exercising through mutual agreement the functions of local self-government. The existence of a great reserve of public lands and a liberal system of disposing of them inevitably led to an intensive individualism which deeply affected the development of our Nation.

The underlying purpose of the Nation to settle its unoccupied lands was dominant in much of the important legislation relative to the public domain. Even the great land grants for internal improvements were based on this thought. Grants aggregating over 10,000,000 acres were made to build and improve highways, canals, and rivers in order to make more public land available for settlement. More than 207,000,000 acres have been granted to the States for various purposes, and more than 158,000,000 to private companies as a subsidy to build railroads, in order to connect centers of population and to secure the occupancy of previously inaccessible lands. Even the great grant to the States of over 65,000,000 acres to drain overflow and swamp lands had for its primary purpose the reclamation of lands for settlement. The problem before the country in the middle of the last century was the occupancy and use of the vast agricultural plains and the fertile valleys of our larger river systems. The

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small-homestead principle operated under such conditions with great success. There were, to be sure, abuses of the law. Often speculators eluded the law and acquired land for its timber and for the opportunity to sell it to others. But where the land was in the main agricultural the homestead law resulted in agricultural use and establishment of farm homes. The success of the policy in settling our great plains and valleys stimulated the Government to still greater liberality. It led to great lavishness in making land grants and to laxity in the administration of the land laws. The feverish haste to get the lands settled developed into a policy of getting the lands out of the public hands as fast as possible, even when they were not agricultural. Finally a policy was developed to secure private ownership for all kinds of public lands except those needed for military use, navigation, and similar Government purposes. Laws were passed not only for the acqusition of agricultural lands, but also for timber lands, and for coal, oil, and other mineral lands. This entire legislation was permeated with the idea of the ownership in small units for the benefit of the individual settler, miner, or logger. An apparent exception to this principle, however, was found in the great land grants as subsidies for building roads and railroads, but these grants comprised only alternate sections, and there was the thought of making accessible and hence available for settlement in small units the interlocking public lands. When it was feared that such large grants might result in land monopolies, Congress stipulated a condition in some of its grants that the railroad companies should sell their lands to bona fide settlers at a price not to exceed $2.50 acre.

The one great mistake made by our Nation in its public-land policy was to overlook the fact that certain classes of land, because of their relation to the public as a whole, should always remain in public control. Forest lands not chiefly valuable for agricultural settlement fall in this class. Likewise do water-power sites, mineral springs, coal, oil and phosphate lands, and certain classes of grazing lands. The special public interest in these classes of lands differs, as do the needs for their public control. But until recently our Government was disposing of all these classes of land to private ownership without reserving any public control whatever.

Lands wholly or for the most part of an agricultural character may be privately owned. The public interest in them is that they be put to productive use. The self-interest of the private owner may be relied upon to accomplish this end. The activities of the Government may be confined to aiding the farmer in applying the best methods of cultivation and improving the country life of the community. In the farming section there are generally certain areas of meager soil not fit for the plow, but suited to timber growth. The farmer's wood lot may be treated as an essential part of his farm, carefully protected from damage and handled intelligently so as to grow repeated crops of wood products for home use and for sale. Many farmers make yearly a substantial sum from their woodlots. The great timberlands, however, in the mountains and on unfruitful sand areas are not suited to farming except here and there where small tracts along the streams, on benches, and on lower slopes may be tillable. Where the timber on these lands is of value it is eagerly acquired by lumber companies, either to log it themselves or to hold for speculation. The United States distributed its nonagricultural timberlands to private persons under a law that enabled an individual to acquire by purchase 160 acres. A great deal was also secured through a perversion of the free homestead law. The presumption was that the individual could develop a small tract of timber, and that small ownership would meet the demand for forest products without the danger of large and monopolistic holdings. Here was another misconcep-

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tion. The operation of timber requires, as a rule, considerable investments in river improvements, roads, railroads, flumes, or other means of transportation, as well as logging appliances, equipment, and buildings. Practical lumber operations require blocks of timber in units large enough to pay to make the necessary investments in improvements. The timberlands, therefore, were rapidly bought by big lumber companies and, at one time, acquired fraudulently in large quantities. The great land grants, furthermore, were used as a basis for building up large timber holdings, sometimes aggregating in the hands of a single company over 1,000,000 acres. It was estimated in 1911 by the Bureau of Corporations that 658 persons and corporations controlled over 62,000,000 acres and over 38 per cent of all the remaining standing timber in the country. The purpose of the Nation to prevent monopolistic holdings of timberlands failed, and the problems arising from the great holdings thus built up will present increasing difficulties in the future.

But it is not merely a question of land monopoly that gives to timberlands special public aspects. The public at large and the local community are interested in seeing that these lands are maintained in a productive condition. This end private ownership can not be counted upon to accomplish. It takes a long time for trees to reach a merchantable size, from 40 to 150 years or more in this country. Private owners acquire the lands for the merchantable timber already upon it, and not to grow successive crops of timber. Their purpose is merely to exploit the timber and not to use the land for timber growth. What becomes of the land after the cutting, whether it burns over or is laid waste, is of little consequence to the private owner. Of course there are exceptions to this rule and occasionally an owner cuts carefully and with a view to forest perpetuation. The rule, however, is the reverse. This is shown by the experience of this country and of foreign countries. In many of the latter the Government found it necessary to impose upon the private owner regulations to guarantee the safe handling of forests. The public is further interested in the right handling of forests because of their influence in protecting the sources of our rivers and streams and in preventing erosion of the mountain slopes. Private owners will not make investments for general public benefits of this kind.

Our country did not come to an appreciation of this situation until it began actually to feel the injurious effects of forest destruction. For many years little or no effort was made to prevent forest fires, either by private owners or by the Government on the lands remaining in its possession. Each year fires were burning over about 25,000,000 to 50,000,000 acres, and destroying much valuable property. Finally, the spectacular destruction of the forests by fire, the exhaustion of the old centers of lumber supply, the increasing price of forest products, the scandals connected with the administration of the public lands, the menace of private land holdings of great size, the appreciable effect of forest destruction on water resources and in causing damage by erosion, and the propaganda carried on by a small group of patriotic and far-sighted men, resulted in a demand by the public for a reform. The public property had already been distributed to such an extent that only about one-fifth of the standing timber remained in the hands of the people. Fortunately, however, much of what was left was located in the mountains, at the headwaters of the rivers and streams of the West, of importance for navigation, irrigation, water power, and domestic use.

The reaction against the old wasteful handling of the public forests resulted in the establishment of national forests, retained in public ownership and administered in the interest of the whole people. The action of the Federal Govern-

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ment in undertaking to handle its own property conservatively and constructively gave a stimulus to the whole forest movement throughout the country. The great States of New York and Pennsylvania had taken steps to protect their properties even before the Government. But it required action by the Nation before the people of the country really appreciated the need of a better care of forests. This opened the way to a wider participation by the public in forest matters through State as well as Federal agencies and introduced the present era of forest conservation.

The national forests were created from the forest lands on the public domain, and were designed to include the bulk of the timbered areas which should be retained permanently in public control. These lands were located chiefly in the western mountain regions, in the Rocky Mountain system and outlying ranges, in the Sierra Nevada, Siskiyou, and Cascade ranges, and in the coast ranges of the whole Pacific slope. The national forest system includes also the south coast forests of Alaska and several forests in the Lake States, in Oklahoma, Arkansas, and Florida, and a small area in Porto Rico. Not only have national forests been established out of the public domain, but under an act of Congress, in 1911, $8,000,000 have been made available for acquiring by purchase forest lands at the headwaters of navigable rivers. Under this law there have been already acquired or contracted for nearly 1,500,000 acres in the White Mountains of New Hampshire and in the southern Appalachian Mountains. There are to-day 155 national forest units in addition to the new forests now being acquired by purchase. These public holdings include 162,773,280 acres of land. Excluding Alaska, the national forests comprise about 30 per cent of the public land, the balance being chiefly grazing lands, though there are several million acres of forest land that should be added to the national forests. The national forests of Alaska occupy about 7 per cent of the publicly owned land in the Territory. In addition to national forests there are 14 national parks, occupying 4,481,606 acres, areas of exceptional scenic features set aside and administered for the exclusive purpose of recreation.

The national forests are not "reservations" in the sense of being withheld from use and development. They are, rather, areas which are being developed under public direction and control, and only such lands are retained in them as should remain under Federal ownership to safeguard the interests of the public. Accordingly, lands of chief value for agriculture are excluded, and there is provision to grant to settlers such scattered tracts of farm land as may occur within the permanent forest boundaries. In this way the wise policy of passing to private ownership the agricultural lands is still in effect even in the national forests. Mineral lands can also be acquired by private individuals, when a bona fide discovery is made, but the rest of the forest land remains public property. The timber is made available for use by sale of stumpage. Lumber concerns contract with the Government for the timber on specified areas in the forests. The trees to be cut are designated by forest officers, and the cuttings are made in such a way as to provide for their replacement by growth. During the last year 10,905 separate lots of timber were disposed of by sale. In addition some 40,040 resident settlers were given free timber for personal use.

In addition to the development of the timber the other resources are put to beneficial use. The forest range is used by nearly 10,000,000 head of stock, under a system of regulated grazing which utilizes the forage without injury to the forest, and which also maintains the productivity of the range. In the same way the development of water power and of water for irrigation is encouraged.

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And, finally, the forests perform a great service as public recreation grounds; no less than 1,500,000 people visit them every year.

Before the national forests were established they were being progressively destroyed by fire. Now the timber is protected by an efficient force of forest officers. During the past season upward of 6,000 fires were extinguished which, if there had been no protection, would have destroyed many million dollars' worth of timber. The water resources are protected as far as the protection of the forest cover at their sources can accomplish this. And the various resources are available, for use and development in a way which provides for their renewal and the continuance of the industries dependent upon them. The forests yield to the Government about $2,500,000 a year. This is not enough to cover all the costs of the Federal forest enterprise, but the annual earnings are increasing rapidly and will within a relatively short period cover the entire cost of forest protection and administration.

As previously explained, the national forests do not include all the timberlands of the country which, in the Nation's interests, should be protected and be kept in a condition of continued productiveness. Undoubtedly, the ownership of Federal lands will be increased to some extent by purchase. But there still remains the problem of the vast areas of forest lands owned by private individuals and companies. While the Government is aiding in this problem through cooperation in fire protection and through its educational work, the chief burden of the solution of the problem of private timberlands must rest with the State governments. The first step in any forestry work is to safeguard the forests against fire. Many of the States have already made effective progress in this direction, no less than 20 having made some appropriation for fire protection work. Furthermore, private owners in many States have organized for forest fire protection and give the States active and valuable cooperation. Thus, the annual loss by fire has already been very greatly reduced. A second step now being taken by a number of the more progressive States is to acquire forest land and establish State forests similar to the national forests. New York now has a State forest of 1,500,000 acres. Pennsylvania has an aggregate of more than 1,000,000 acres. The movement for building up State forests will grow and result in a very considerable increase of forest land owned and controlled by the public.

The forest problem of our country is, however, by no means solved, nor is its full solution even in sight. Only a few of the States have as yet taken definite steps in forestry. There are also probably a hundred million acres or more of private timber lands which are not protected nor handled in a way to be a productive asset to the States or communities. To bring all of the forests of the country under an efficient protection and administration, we must first extend our Federal and State activities in preventing fires and ultimately take over much larger areas of land into public ownership or else, as is done in foreign countries, exercise some control over it to prevent its devastation.

A good illustration of a tropical country in which Government ownership of nonagricultural forest lands is being worked out in a most advantageous manner to the people as a whole, is that of the Philippine Islands. Four-fifths of the entire area of the archipelago is public land, and by an act of Congress not an acre of it may be relinquished unless it can be proven that it is more valuable for agriculture or for some other purpose than for growing timber. A splendid beginning in public forestry has already been made, a technical service built up and policies established for development of the resources under public control. The continuation of a strong public policy of forestry in the Philippines is of the most vital importance to the welfare of the people of the islands.

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Under no circumstances should this country take any action that would in any way weaken the public control of the forest lands in the Philippines. There is in the Philippines, just as in this country, constant pressure from interested sources to break up the public forests and throw them open to private acquisition. The importance of retaining full Government control over the public forests must especially be borne in mind at this time when the question of greater autonomy for the Philippines is before Congress. Without safeguarding the Philippine forest resources for the benefit of the people as a whole, it may turn out that the Filipino when he gains his independence will have few resources on which to be independent.

I have explained the necessity for participation by the public in the forest problem and have emphasized the need for public ownership of timberlands in the nonagricultural regions. Equal emphasis should be laid on the need of efficient administration of them. Otherwise their purposes can not be accomplished. The administration of forest lands with a view to use combined with perpetuation is essentially technical in character. The very nature of the forest problem requires stability of policies and a consistent plan of development extending over a long period of years. Constructive handling of the national forests in the United States began when they were placed in the Department of Agriculture and given a technical administration by a corps of men trained in forestry and entirely divorced from politics. The continued sucess of the national forest enterprise depends on the strict adherence to the principle of their administration by trained men and along technical lines. Routine and perfunctory handling of public property inevitably means inefficiency and failure to secure from the forests the service the public sought in maintaining them. A political organization means frequent changes in personnel, unstable policies, unbusinesslike administration, and either negative results or public loss. As already proved in this country, and repeatedly proved in other countries, success depends on a sound scientific management of the forests by a stable organization of trained and experienced men.

Forest conservation has been carried on in this country only a relatively short time. We have, however, had a very long experience in forest destruction, and this has demonstrated to us the need of forest conservation. A forest policy for a nation, as proven by the experience of the United States, should be based upon the following considerations:

1. Private ownership can not be counted upon to maintain forest lands in nonagricultural sections in a productive condition, nor to protect water resources and mountain slopes by maintaining a proper forest cover.

2. The public interests in handling of forest lands are so great and the injurious consequences of forest destruction so far reaching that in its own protection a nation must take steps to prevent wasteful destruction of its forests.

3. Forest land in agricultural regions where it forms a part of the farm itself should be privately owned and handled as one of the farm crops. Nonagricultural timberlands in the mountains and at the headwaters of streams should be owned outright or controlled by the public.

4. A nation owning public lands should therefore retain title to its nonagricultural timberlands. The experience of the United States indicates the wisdom of segregating public lands according to their chief use before beginning to dispose of them, so as to prevent the loss of rights which the public should retain in perpetuity.

5. The cost of correcting mistakes resulting from granting away lands whose management so vitally affects public interests as forests is always very great. This applies to the great cost of buying back lands, which must be paid for at

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existing market prices; it applies also to the building of engineering works to check erosion and floods caused by forest destruction.

6. Public ownership and control of forest lands does not retard development. On the contrary, such ownership insures permanence of industry in forest communities. Private ownership, on the other hand, results in temporary occupancy during the process of exploiting the timber and is followed by exhaustion of this resource and often by depopulation.

7. Unless there is a strong, efficient forest organization composed of technically trained men and free from political pressure definitely placed in charge of all the public timber resources of the country, the protection and management of these resources will remain largely a dead letter.

These are the fundamental principles which the experience of the United States and of many other civilized countries has shown to be essential to the success of a national forest policy. Any nation that fails to grasp them must face the danger of a great national loss, which, if it ever can be restored, will demand great sacrifice. Fortunately for most of the South American countries, the bulk of the public forests are still under Government ownership. Every opportunity is thus presented them for inaugurating a wise national forest policy which will contribute to the great future development of South America.

## THE PEOPLE'S INTEREST IN WATER-POWER RESOURCES.

By GEORGE OTIS SMITH,
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The people's interest in water power is served only through use. Since flowing water is a continuing source of power, the contribution of this resource to the public welfare is proportionate to the promptness and efficiency of the development of every power site. Wherever the resulting energy can be put to work at a cost justified by results nonuse of a water power is an economic waste. It is well, however, to qualify the statement of an eminent authority that from the conservation standpoint "any use is better than no use at all."[1] A more farsighted view is desirable; better not even a partial development now if thereby the full utilization that may be needed in the near future is blocked.

From the standpoint of the public what is needed in water-power utilization is efficient development that will meet present market demands and effective regulation that will secure to all the parties interested a participation in the benefits of that development. This may seem a simple program, but its large importance comes from the fact that water-power resources will possess much greater value to society in the future.

The stage at which we find power development on the public-owned sites to-day is simply this, as described by Secretary Lane in his recent report: "The Government was generous, but it had no intention of being a spendthrift. When it found itself being imposed upon * * * the Nation stayed its hand and drew back, so as to make sure of the right course. It wished use—use by as many as possible and the best use."

It is this logical desire for the best use, in which the largest possible number may share, that makes the utilization of water power a live issue. Unwarranted

[1] Swain, G. F., Conservation of water by storage, p. 27, New Haven, 1915.

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fear of impending monopoly may have led some to urge a halt in all development, while blind disregard of a changing order of things has caused others to denounce any restriction. The practical observer of the times, however, recognizes a greater danger of monopoly because of nondevelopment and a larger security through regulation.

The engineering fact that stands out in the utilization of water power is the comparatively high efficiency of large systems. Lower costs of operation and better service are results that appear to follow naturally the creation of these combinations of power plants.

The combination of several water powers differing in character in order to serve many markets having diversified service requirements makes possible an economic adjustment of supply to demand, and thus the result is a natural tendency to State-wide and even interstate units of operation. Nature's irregularities are thus equalized and man's varied requirements are similarly balanced. The Western States, in which these large hydroelectric systems have been mainly developed, show the largest per capita consumption of power and the lowest average rates. The centralization of power development is accompanied by a large market and diversified use; and the resulting high-load factor has made possible low rates, which in turn have encouraged the more general use of power, until in a State like Montana, which leads in per capita consumption, the people put electric energy to every use on the ranch and in the home, while in the mines and smelters and on the railroads electricity is displacing steam. The influence of this cheaper power on the mining industry, for instance, can be realized in part by considering the fact that one mining company, by substituting hydroelectric power for steam, effected an annual saving of nearly $2,000,000. Translated into terms of copper ore, this means a saving of about 50 cents on a ton of ore, thus permitting the mining, with an equal profit, of ore that much lower in grade than could be mined when steam-generated power was used. This illustrates the wide public interest that may be served through the efficient operation of large units. Conservation of this sort means much to the whole Nation.

Such are the advantages to the people that are possible through hydroelectric development as a natural monopoly; it remains to make the possible advantages actual. It is the recognition of this interdependence of the corporation serving the people and of the people served by the corporation that has developed, only in the last eight years, this idea of effective regulation of public utilities. In the illustration just used there exists a certain community of interest between the power corporation and the mining company. The moral is plain—a similar community of interest needs only to be created between the public-utility company and the people it serves.

If the subject for discussion is the constitutional basis for public control of water-power resources, the opportunity is large for those who look backward over the decades of progress; but the purpose of public control is a simpler topic, which can be discussed by those who see clearly present conditions and look forward to the time when full utilization of every natural resource will become more essential to society.

The oft-debated question whether the relation of the Federal Government to water-power sites is that of proprietor or that of sovereign is only incidental to the real issue of the people's larger interest as the consumers of power. Herein lies the purpose of certain legislative proposals that have been misunderstood by some and perhaps misrepresented by others. What has been termed an arbitrary control is not an attempt to sell something the public does not possess, but an effort to protect and safeguard the future interest of the public consumer. Whatever the governmental agency, Federal, State, or

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municipal, any or all will become more and more active in the public interest. The method of control may be based upon public ownership of land, police powers, or preservation of navigation; the primary results sought will be public protection. Once certain natural monopolies were recognized as the proper possession of the sovereign prince; later the divine right was regarded as inherent in certain large corporations; to-day the sovereign people have begun to claim a share in the benefits that naturally flow from a natural monopoly. These public utilities are in the natural-monopoly class simply because the community requires centralized service; a large part of the value of the monopoly originates in the community, and the people's right to a share in the benefits is therefore fundamental.

The New York Public Service Commission had under consideration two years ago the question whether a hydroelectric company had the vested right to sell low-cost Niagara-generated energy at the price of high-cost steam-generated energy and pocket the profits. The decision was plain enough to settle this issue wherever it may be raised. Recognizing fully the claims of the company for a liberal return upon its capital invested, the commission concluded its discussion of the case with these words:[1]

> But to say that the public is entitled to no advantage from the use of these waters, that the territory which can be served with electric energy developed at Niagara Falls has no advantage and is entitled to no benefit by reason of proximity to those Falls, is to say something which does not appeal to the best judgment of mankind for an instant.

Engineering skill has created through the turbine and the long-distance transmission line a public utility of the first rank; it is now a problem in social economics to secure for the people the real advantages of these modern inventions. Too often in the past the wealth won by the engineer from the mine, the forest, or the stream has been monopolized by the capitalist. Experience is teaching the American people to regard industrial development as a public matter, in which others than owners of stocks and bonds are concerned.

Too often the public interest in water-power resources has been discussed almost wholly in terms of compensation, tolls, and charges for the publicly owned resources utilized. The revenue idea connected with this conservation issue has been allowed to overshadow the thought of control in the public interest. A notable exception to this tendency is contained in the Pend Oreille permit issued in 1913 by Secretary Lane, which provides that after the ten years allowed for construction of plant and development of market the rate of compensation to the Government shall vary inversely as the square of the proportional development of the site and directly as the square of the average price charged for electric energy to both customers and consumers. While protection of the ultimate consumer is the purpose of these terms, the return to the Government, as will be seen, is determined by the receipts of the operator. Here the objects plainly sought are prompt and complete development and low rates to the public rather than revenue to the Government.

The most notable sign of the times is the general acceptance of the principle of public control. A recent editorial in the Stone & Webster Public Service Journal[2] thus sums up the whole issue:

> Still, it is a fact that public regulation has come to stay, and when its methods are reduced to the scale of absolute justice and sound economics it should prove of inestimable advantage to the country.

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[1] New York State Pub. Service Comm., Second Dist., Reports of decisions, vol. 3, p. 671, Apr. 2, 1913.

[2] Oct. 15, 1915, p. 230.

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When applied to water-power resources, as to other public utilities, regulation by public agencies needs to begin in the initial stages of development. The terms of the contract between the public consumer of electric energy and the private builder of the hydroelectric plant can best be considered before a stone is laid.

No appeal for public welfare should obtain a large hearing that fails to express an equal desire to do justice to the individual or corporate owner as well as to society in general. Hence, in any discussion of the future conduct of the water-power business, one of the essential premises is the condition of proper return. This idea is at the foundation of public regulation of private business, but even beneath this is the query, A fair return upon what? Thus it is that in considering the social side of an engineering subject like water power, we find ourselves confronted by questions of capitalization and valuation. From the technical discussion of rates measured in cents per kilowatt-hour we turn to the economic questions of equities based upon "intangibles."

The present trend in the determination of the proper basis for rate regulation appears to be away from valuations derived either from cost reproduction or from capitalization or current stock-market quotations of the securities. As stated by Commissioner Lane in the decision of the Interstate Commerce Commission in the Western Advance Rate case:[1]

Perhaps the nearest approximation to the fair standard is that of bona fide investment—the sacrifice made by the owners of the property—considering as part of the investment any shortage of return that there may be in the early years of the enterprise. Upon this, taking the life history of the road through a number of years, its promoters are entitled to a reasonable return. This, however, manifestly is limited; for a return should not be given upon wastefulness, mismanagement, or poor judgment, and always there is present the restriction that no more than a reasonable rate shall be charged.

The same thought was expressed by Commissioner Thelen, of the California Commission,[2] in these words:

After a consideration of these and other fine-spun theories, the mind of a practical man instinctively turns for first guidance to the simple question of the amount of money which has been honestly and wisely invested.

And to show that this idea is winning nation-wide acceptance, an even later opinion by the Massachusetts Public Service Commission may be quoted as setting forth the guiding principle of regulation—that both the public using the public utility and the public investing in the utility company are best served when the effort is "to protect investments honestly and prudently made and wisely managed." The Massachusetts commissioners[3] declare that—

Any other theory involves essential injustice; tends to make the development of our public-utility companies a speculation and not an investment; operates as a premium upon various kinds of fraud; invites into the public service undesirable manipulators instead of sound, level-headed business managers; * * *

Accordingly, we rule that under Massachusetts law capital honestly and prudently invested must, under normal conditions, be taken as the controlling factor in fixing the basis for computing fair and reasonable rates; that if there is mismanagement causing loss such loss must be charged against the stockholders legally responsible for the mismanagement.

There is, however, another side to the justly condemned system of watered stock. In the past "water" of this type has represented in a way the capitali-

[1] Feb. 22, 1911: Interstate Commerce Comm. Decisions, vol. 20, p. 347.

[2] Railroad Comm. California Decisions, Antioch vs. Pacific Gas & Electric Co., vol. 5, p. 88, 1914.

[3] Massachusetts Pub. Service Comm., vol. 2, pp. 108–111, 1914.

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zation of the risk, so that if the financing of a public-utility project is now to be put upon the sound basis of actual cash received and expended, the risk element inherent in an engineering venture of this kind, especially in its early stages, must be recognized and provided for. This provision can be made only by permitting returns to invested capital at rates much higher than the return on municipal bonds. The possible profits must be adjusted to the possible risks.

This recognition of the economic justice of a higher rate of profit must look ahead to future operation as well as back upon the period of construction. If under commission regulation the so-called "unearned increment" is not to accumulate as a basis for future rate making, then some other premium must be placed upon successful operation.

The practical ideal in public regulation is to allow such returns to the private owner and operator as may encourage engineering and executive efficiency. To fix a maximum rate of profit based simply on capital investment might effectually veto improvement in plant or operation beyond the dead line thus established; therefore, the prize of a larger return must be held out to those who make the largest and best use of the natural resource. In the absence of the competitive element the returns to be derived by the private holder of a natural monopoly should be restricted so far as they depend primarily upon his use of the resource which society owns or to which society gives value, but a quite different method of regulation may well be applied to the profits that come from his continued investment of gray matter. Such ability and industry need not be capitalized, yet betterment of service should produce benefits in which both investor and consumer may share.

Adequate incentive to greater efficiency combined with full recognition of the people's interest may be provided by any of several methods; the sliding-scale plan adopted for the Boston gas companies makes larger dividends to stockholders contingent on lower prices to consumers; the Chicago street-railway ordinance provides for the division of profits above the fixed rate between the company and the public; a profit-sharing plan worked out by the manager of a Wisconsin power company divided excess net profits equally between the company and the consumers. In each of these plans the principle is the same; the investing public and the consuming public are partners in the enterprise, and the duty of the Government is to exercise its protective power in the interest of the private owner of a public utility no less and no more than in the interest of the public user of that utility.

It is in the streams and rivers and the sites adjacent to them that the people have the largest interest as the future source of power. The present installation of water-power plants in the United States is estimated at 8,500,000 horsepower, representing a probable investment of nearly a billion dollars—exclusive of transmission and distribution systems. The estimated undeveloped power possible without storage in the country, exclusive of Alaska, amounts to 55,000,000 horsepower, one-half of which is on publicly owned sites. For much of this power there are no available markets, and under present conditions development would not be feasible; yet these estimates afford at least a qualitative expression of future possibilities.

Of the two fuels that can be considered as the competitors of water in power generation, petroleum has probably already passed its maximum of production, and the life of this source of power is to be measured by only a few decades. The coal resources of this country, on the other hand, are so large as to promise an abundance of fuel for scores of generations. Yet the price of steam coal shows a steady advance, offset, it is true, by increased

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efficiency in steam generation and utilization, but eventually the relative importance of water power the country over must increase.

Already the great development of hydroelectric power in California in competition with oil and in Montana in competition with coal forecasts the future relation of industry to this source of power. In these and adjoining States irrigation and mining and transportation depend in larger measure each year upon hydroelectric energy, and it is because of this increasing contribution to the industrial life of the Nation that public service and public utilities are more than names when applied to the utilization of water power.

In considering the future of water power it is important to note that because it utilizes a nonexpendable resource, hydroelectric energy, unlike coal or oil, needs no allowance for amortization, but its price to the consumer can be based directly on its cost to the operator. Herein lies the public interest in every phase of present-day regulation of water-power development that may affect future cost of water-generated energy. It is simply national foresight to see to it that the public utilities organized to-day for private operation do not include promoters' hopes or speculative land values in the capitalization upon which future power users might be asked to pay returns. It has been aptly said that "the public utility is not formed to speculate in land."

Cheap power promises to be in some future century this country's largest asset in the industrial rivalry among nations. Our unsurpassed coal reserves reinforced by these water-power resources constitute a strong line of national defense in that they form the real basis for an industrial organization of the Nation's workers. It is only through abundant and well-distributed power that the other material resources of the country can be put to their highest use and made to count most in the Nation's development. The people's interest in water power is greatest in its promise of future social progress, and such an interest is well worth protecting.

## RELATION OF THE GOVERNMENT TO THE MARKETING PROBLEM.

By BEVERLY T. GALLOWAY,

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The marketing of farm products is an extremely complicated problem. Manufacturing involves the observance of certain fundamental rules and principles which may be formulated and shaped into a code of action. The production of crops from the soil is an art supported by science, and this art lends itself more or less to certain given principles and rules that may be catalogued and applied. Marketing, on the other hand, is empirical. There is no science, and there is yet little system to it. Hence, the field for its development is open.

In this paper we are concerned only with the marketing of farm products, which is even more complicated than the marketing of manufactured materials. To obtain a proper conception of what might be the Government's relation to this problem in the future, we must look back and view what has been the Government's attitude on similar matters in the past.

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### THE INDIVIDUALISTIC ATTITUDE.

Our people are worshippers of the fetish of independence—the right of every man to go his own way, mind his own business, conduct his own affairs, and let the body politic take care of itself as best it may. About the last thing that comes into the mind of the average citizen is the thought that what is good for the hive is good for the bee. The usual concept is to take care of the bee first; the hive can take care of itself. The reflection of this spirit is seen everywhere—in our scheme of education with its hundreds and thousands of little independent units at once the most wasteful, illogical, and inefficient, perhaps, in the world; in our whole system of land settlement and land allotment, whereby the dweller has been compelled to isolate himself and make his way without opportunity or hope of community life; in the organization and development of legislative bodies, the members of which are expected first of all to look after the interest of the particular ward, county, district, or State they may represent, and as a secondary consideration to look after the welfare of the country as a whole. This state of affairs is not confined to the United States alone. It is more or less prevalent in the whole of our Western Hemisphere, and is in part due to the fact that heretofore the public has had plenty of room for expansion and expression. We are now beginning to crowd each other. We can no longer move about as freely as formerly, and we are feeling the need of combined effort and collective effort in solving the new problems that are rapidly arising.

To further complicate matters we find the farmer, the man who produces so much of the material to be sold, not long removed from a period when the farm was self-contained. In a good many sections the farmer can still manage to live fairly well on what he produces at home and on what he can sell and barter near by. It is beginning to dawn upon him, however, that with all the rapid economic changes he is more and more being brought into competition with the world, and that as an individual he is unable to cope with the situation. In his bewilderment he appeals to the State, with the result that there is much scurrying and scuttling here and there, and innumerable bills for relief are introduced, which seldom accomplish anything except, perhaps, secure a few votes for the introducer. This procedure may continue indefinitely until out of it there is gradually developed some plan or policy that will be far-reaching and permanent in its effects. This is economic evolution in a democracy—a tremendously wasteful and costly proceeding, but in the end occasionally successful.

### THE TRIAL PERIOD.

It took nearly half a century at a cost that no one can tell to evolve a system of currency that from its very simplicity one is amazed that it was so long in coming. It seems fairly reasonable, therefore, to surmise that in the marketing of farm products and the Government's relation thereto we must look forward to a considerable period of shifting and changing, and more or less uncertainty while education is doing its work, until through one means or another the people are brought to think and act in terms of community effort. For the marketing problem now and in the future is a community problem, which means that any country founded on the tenets of a democracy must first heed the great call for educational effort in order to bring all the people to a realization and understanding of the need, the important need, of working together. We would, therefore, put down as a first step of the Government in the marketing problem the development of a definite policy in educational work looking toward what



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may be called social preparedness. This is a legitimate problem for the State, which all of us with the highest ideals of a democracy at heart can thoroughly approve. To educate for social preparedness, to develop from within the desire and the spirit to work together, rather than have to be forced to work together, is certainly worthy of our best effort.

We now have the opportunity of studying something of the workings of these two methods in the deplorable conflict that is shaking civilization everywhere. What the end will be we do not know. I think that many of us, however, are ready to admit that some of our theories as to the powers and influence of a representative democracy will have to be revised.

### THE EVIDENCE OF THE NEED.

That the people are awake to the needs of the matter is evidenced by the demands for help and light. Good beginnings have already been made, and it is gratifying that our own Department of Agriculture is taking the lead in this work. Through its Office of Markets and Rural Organization and its States Relations Service there are being developed lines of work that will lead to far-reaching results in establishing safe and sane principles.

This work offers a great field for our agricultural colleges. It must be developed, however, through a new form of teaching and a new kind of teacher—a form of teaching that is concerned less with academic theories and more with the real everyday affairs of life, and a new kind of teacher who knows life and its problems rather than books and the problems they present; a form of teaching and a kind of teacher that will bring about "a wise and just evolution of our social and industrial problems, the union of clashing elements in our population, the adjustment of differences, the wiping out of bitterness, the establishment all through our social and industrial life of a justice so patent that none but the unjust can doubt it." These things can not be accomplished by Government fiat, but the Government can lend its aid by liberally supporting all properly organized educational agencies engaged in the work.

As we come to view this type of effort at close range it becomes more and more evident that it must be based on a systematic study of the real facts of working together, rather than the theories of collective effort. For a time at least we shall need to be concerned more with the facts as to what has been done than with the theories of what might be done. There is a vast fund of fact that could be made immediately usable if it were properly brought together, sifted, assimilated, and put into teachable form. All the issues are now much confused by the action and operation of many types of so-called cooperative or collective agencies whose primary object is pecuniary gain for the few rather than the establishment of fair and just relationships and mutual helpfulness for all. It will require a decade of active educational work to bring about a proper understanding of some of these matters and to bring our people to a state of mind necessary to be able to proceed with broader and better constructive plans. Nothing will accomplish so much as the mere bringing of the people together to discuss the questions at issue under agencies that will guide and not attempt to direct. Already the Government of the United States is laying the foundation for future work of this nature through the organization of a broad scheme of extension work localized in counties but guided by a comprehensive scheme of cooperation through the colleges of agriculture in the respective States. I refer to the cooperative work of the Federal Government with the State colleges in the conduct of the county agents' activities.

Briefly, then, one of the first functions of government in relation to the marketing problem is to develop, through properly organized educational work,

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a state of mind, a real knowledge of the broader questions and issues, and a true understanding and appreciation of the social, moral, ethical, and business questions involved. The State, and the State only, can do this, but up to this time the State has done but little, and it must be admitted that as yet we are all groping as to the method that should be employed in developing social consciousness.

### LEGISLATIVE NEEDS.

A second and vital function of the Government or State in relation to the marketing problem has to do with the securing of uniform legislation affecting legitimate organized effort in the field of marketing farm produce. We can sweep aside at once all those proposed forms of legislation that aim to do the things for the producer that he ought to do for himself. There should be no place anywhere in all these matters for development of anything like class legislation. The farmer does not need and should not be regarded as needing special privileges from the Government. There may be times when this appears to be the case, and our dangers lie in the direction of misconceived action in the belief that the difficulties can be met and overcome by Government fiat rather than the observance of economic laws. We do most sorely need, however, uniform constructive legislation which will establish and maintain the principles of justice between the producer and the consumer.

Here, again, we are confronted, in this country at least, with another fetish that has blocked progress for 50 years, and that is the fetish which holds that in vital matters affecting all the people all the time we must recognize certain arbitrary and more or less meaningless boundary lines and provide for the people within these lines as if they were beings apart from all the other people. This policy, based on conditions which as a Nation we have long since outgrown, has had more to do with holding back progress in some of the larger questions concerning the welfare of our people than almost any other one thing. View the situation with reference to protecting the life and health of all the people. Surely this is not a local question to be met by setting up certain health laws in one place and very different ones in another place. Pure food is pure food wherever found. Food can not be pure and wholesome in Maryland and Virginia and the opposite in the District of Columbia. The distressing blight of child labor, which certainly concerns the Nation as a whole, we can not check or mitigate until there is some assurance of legislative uniformity throughout the entire land. If there can not be uniformity of legislation which will guarantee to the producers of the necessities of life a fair share of the profit therefrom, or at least a living wage, then democracy is a failure and some other form of government must be devised. It would seem, therefore, that the Government may very properly direct its energies toward the question of uniform legislation under which and through which the producers of farm crops may organize their industries along lines that are safe morally, ethically, socially, and economically.

### THE PROBLEM OF CONTROL.

The Government may establish principles of action, may go so far as to demand that these principles should apply uniformly, and may very properly take the stand that it will see to it that the principles are lived up to by all parties concerned. How otherwise are our people to receive social and economic justice? I believe it has been the general rule that whenever the producers of an agricultural commodity have attempted to concentrate for the purpose of securing additional control of their product, the business eventually passed

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into the hands of nonproducers, owing largely to the absence of proper protective laws or of any laws whatever. These nonproducers then proceeded to organize the business and to conduct it not so much with the object of rendering justice to the producer and consumer as for the purpose of insuring the largest profits to the organizer permitted by the laws of the land and by the conscience of the operators.

We have only to recall what has taken place in this country in the past 35 or 40 years to realize what these changes mean. In the handling of cotton, of grain, of meats, and of milk, all vital to our welfare, we have seen uncontrolled concentration developed to the point where the concentrators so well controlled the situation that those who provide the raw products can no longer afford to take the risks; hence they give up the business. The raising of cattle in the Middle West is no longer a business with the farmers. It is a gamble. The milk situation is very little better. It must not be understood that we are advocating specific legislation and Government action to correct all these matters. The greater number of the problems can be met, as we have already pointed out, by the extension of knowledge and the further encouragement of all those things that Government may do in the direction of stabilizing agriculture. Proper crop rotations, systems of farm management, prevention of losses to crops and animals through diseases and insect attacks, adaptation of crops to soil and climate, introduction of new crop industries, and the breeding and improvement of plants and animals will all tend toward stabilization.

### FIXING GRADES AND STANDARDS.

The Government may very properly play another important rôle in the marketing problem, and that is in lending its aid in the matter of determining and fixing standards. Many of our existing difficulties would be overcome if trading in agricultural products could be done upon a basis of fixed grades and standards—standards and grades that would be recognized as fair and just to all parties involved. The Government, and the Government only, can determine the principles and factors upon which these standards and grades should be fixed. To make such standards and grades effective and acceptable without question will require much painstaking scientific and technical work. Here is an important function of Government, and one that should be fostered and encouraged in every way.

Government may also very properly function in developing the principles which should govern in the storing and warehousing of farm products. Undoubtedly our food supply would be greatly stabilized and the violent fluctuations in prices, detrimental to both producer and consumer, could in a measure be overcome by a proper system of regulated storage. Here, again, we must guard against the fallacy that relief will come through mere legislative action without regard to the fundamental economic, biologic, chemical, physical, and other laws involved. For example, a mere fiat that eggs should not stay in storage longer than 30 days or 90 days will not solve the problem of the storage, marketing, and distribution of eggs.

Finally, the question may be asked whether the Government might not very properly function in the gathering and quick dissemination of information regarding perishable products which would be helpful to producer and consumer alike. The United States has developed one of the best weather services in the world. Its daily weather reports, obtainable now in every little hamlet and farm home, are of incomparable value to agriculture, to commerce, and to all industries. There has also been developed a most thorough and efficient system of crop reporting. Some preliminary work has been done by

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the United States Department of Agriculture in this informational marketing field. This work to be effective must necessarily be expensive, and it is a question whether the lack of knowledge on the part of those who most need it will not keep them from knowing how to use it. The knowledge will come, however, and a combined climate, crop, and market informational service is something that should be looked forward to in the consideration of any questions having to do with the relation of the Government to the marketing problem.

To summarize, it may be said that the Government's relation—and by Government we mean the State—to the marketing problem is primarily one of establishing principles; of educating the public to a full knowledge of the economic, ethical, and moral questions and issues involved; of the development of social preparedness and social consciousness; and of establishing and maintaining social justice to the end that all men at all times shall receive due compensation for the labor of their hands and minds.

## Adjournment.

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## JOINT SESSION OF SECTIONS III, V, AND VII.[1]

PAN AMERICAN UNION,
*Tuesday night, December 28, 1915.*
Chairman, WILLIAM L. SAUNDERS.

Papers presented:

The conservation of human energy, by T. N. Carver.

The functions of foods in securing national efficiency, by H. W. Wiley.[2]

Work of the United States Office of Public Buildings and Grounds, by Col. W. W. Harts.[3]

### THE CONSERVATION OF HUMAN ENERGY.

By T. N. CARVER,
*Professor of Political Economy, Harvard University.*

The most valuable resource of any country is its fund of human energy—that is, the working power, both mental and physical, of its people. So far does the value of this resource exceed that of any other that it is safe to say that a capable race of men who will conserve, economize, and utilize its working power will not only extract a living but actually prosper in the midst of poor natural surroundings; whereas, an incapable people, or a people who waste and dissipate their energies, will decay in the midst of the richest natural surroundings.

New England furnishes a good illustration of a capable people in the midst of poor physical conditions, with a bleak climate, a sterile soil, and the absence of minerals, who yet prospered amazingly. The only possible explanation is that through the conservation of their working capacity they had overcome these natural disadvantages. The economic virtues of intelligence, industry, thrift, sobriety, and mutual helpfulness have enabled them to achieve what other peoples have frequently failed to achieve in the midst of rich surroundings, because they have wasted and dissipated their fund of human energy through ignorance, idleness, unthrift, and mutual antagonism.

Civilization has been variously defined, partly because civilization is a variegated and many-sided thing. One of the best of these definitions is that civilization is the progressive elimination of waste. If the most valuable resource of a country is its fund of human energy it would follow that the most destruc-

[1] The stenographic report of this session is found in Vol. VI of the Proceedings of the Second Pan American Scientific Congress.

[2] Paper printed in Vol. VIII of the Proceedings of the Second Pan American Scientific Congress.

[3] Paper printed in Vol. VI of the Proceedings of the Second Pan American Scientific Congress.



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tive waste would be the waste of human energy. Among the most conspicuous forms of waste are idleness, ignorance, luxury, vice, and distraction. Idleness may be subdivided into the two main forms of involuntary and voluntary. The most conspicuous form of involuntary idleness is that which we see in the great army of the unemployed. This, however, is very much less important than voluntary idleness, for two main reasons: First, the involuntarily idle are, broadly speaking, the least valuable members of society. They are the people with the least capacity for doing useful work, with perhaps many brilliant exceptions, such as an unappreciated genius who might be doing valuable work if the people whom he could serve only had the wisdom to appreciate his services. Generally speaking, however, it is safe to say that the army of the unemployed is not made up in the majority of cases of geniuses. If a piece of sterile or stony land lies idle we do not consider it much of a loss, for the reason that, even if it were in use, its product would be very low. If, on the other hand, a piece of rich and fertile land lies idle, we have a right to consider it a much greater loss, because if it were in use its product would be large. The same process of reasoning would lead to the same conclusion with respect to human talent or working capacity, or human energy as it will be called in this essay. Men of little capacity, men whose productive energy is limited or merely oversupplied, are not capable of producing much, even if they are busy; therefore, the community does not lose much when they are idle.

The only question that is likely to be raised with respect to this conclusion is whether the mere fact that a certain kind of labor is oversupplied tends to make it unproductive. If we were discussing anything else except labor, I think even this would not be questioned. The confusion with respect to labor is partly sentimental and partly due to defective analysis. One form of defective analysis is embodied in the statement that since labor produces all wealth, therefore labor can never be oversupplied. The reply to this is that the kind of labor which is unemployed does not produce all wealth. It has to be combined with certain other kinds of labor before it can produce anything to speak of. The miller could not produce flour unless there were farmers growing wheat. There might easily, therefore, be an oversupply of millers in any community. Again, the millers could hardly sell their flour if there were no bakers; and a scarcity of bakers might therefore make on oversupply of millers in any particular time and place. So the men who are on the bread line in the time of unemployment may represent kinds of labor which are oversupplied even though labor in general is not.

If the proposition that labor produces everything really meant very much and were capable of practical application, one ought to be able to go to the men on the bread line and say to them, "Gentlemen, you are laborers; labor produces all wealth; therefore, produce wealth." The utter senselessness of this proposition would at once appeal to every hearer. It takes several kinds of labor to produce real wealth, and a scarcity of one kind may make a superabundance of another kind.

This is the method of reasoning and analysis which we apply to everything else except labor. Not long ago I was at the home of a professor of agriculture in one of our leading agricultural colleges. The grass was growing up through the cracks in the brick walk in front of his house. He put fertilizer in the cracks to kill the grass, and it worked effectually because there was too much fertilizer and not enough of the other elements of plant growth. With an abundance of soil and moisture and other elements of plant growth, the fertilizer would have made the grass grow faster. In that particular case, where the other elements were absent, the fertilizer was not only nonproductive, but

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absolutely destructive. Cases of a similar character are continually coming to our attention. Some of our soils are already too rich in nitrogen and deficient in potash. The ordinary fertilizer rich in nitrogen is not only useless on such soil; it may be destructive. Yet nitrogen in its proper proportion to other things is a highly productive ingredient in fertilizers.

But we need not go into soil chemistry to find similar illustrations. In some parts of the country water has to be drained off the soil because there is too much; in other parts water has to be put on the soil because there is too little. To attempt to sell water to a farmer whose land is already too wet, on the statement that water is necessary to all plant growth, would be no more futile than to try to sell a certain kind of labor to the man who has a surplus of it, on the ground that labor produces all wealth. Therefore, even if the members of the army of the unemployed are not less capable on the average than the members of the army of the employed, if they merely represent an oversupply of special kinds of labor, their labor becomes of as little value to the community as water to a farming community in the humid belt. To be sure, it might be said that this labor would be valuable if it could be trained to do something else. These phases of the question will be discussed under the heading of ignorance.

Speaking of the superabundance of water in one place and a scarcity in another suggests a certain anology to the labor market. If there is too much labor of a certain kind on one spot, it does not solve any problem merely to point out that there is an abundance of land in Texas, unless some measure is taken to get that labor removed from the spot where it is overabundant to the spot where it is underabundant or scarce. It is true that much of the talk about moving labor from one place to another is exceedingly unintelligent, because the speaker frequently has no real knowledge as to the opportunities for labor in other places. To point out that there are many vacant acres in the Desert of Sahara is not conclusive evidence that there is an opportunity for labor there. Before we attempt to move labor from one place to another, we must be quite certain that there is an opportunity for the kind of labor we are about to move.

There appears to be a much greater need for the occupational redistribution of the labor supply than for the territorial redistribution. By the occupational redistribution, I mean the training of labor for those occupations where men are scarce and hard to find, and out of, or away from, those occupations where labor is abundant and easy to find. This again will be taken up under the subject of ignorance.

A great deal can doubtless be done also by finding work suitable for the involuntarily idle in the place where they are forced to live. The Massachusetts School for the Feeble-Minded has carried out a very successful experiment in this direction. About 300 of the more capable men and boys of the institution are placed on a farm where their labor can be utilized in the work of clearing stones, draining the land, and doing other rough work. The result is that the State now has several hundred acres of highly productive land where formerly it had nothing but rocky land grown up to brush and briars. The fund of labor which is thus utilized is about the most unpromising kind of labor which any State possesses. But it serves as an illustration to show what can be done toward the utilization of waste labor power when we go at it intelligently.

Another class of waste labor power is found in the aged men who have become incapacitated for the work to which they were trained in their youth. The inventor who can devise methods of utilizing this considerable fund of

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human energy will be a large contributor to the civilizations of future generations, referring again to the definition of civilization as the progressive elimination of waste.

We are not likely to be overcautious, however, against the mistake of saving at the spigot while wasting at the bunghole. It is sometimes cheaper to support men in idleness than to give them work; that is, we may lose more on their work than it would cost us to support them. A bungling or inefficient laborer who is handling valuable machinery or perishable materials may destroy more than he produces. The problem of the inventor is, in this case, to find the kind of work for waste labor which will at least reduce rather than increase the cost of keeping it.

As to the voluntarily idle—that is, the leisure class—it is generally true that they possess large natural capacity. Occasionally, it is true, there may be an imbecile living on inherited wealth, just as before stated there might be geniuses out of work; but on the average and in the long run, they who have achieved a fortune which enables them to retire and live in idleness must have possessed considerable ability. If that ability is misdirected, it is no less a loss than if it is idle. This ability is like the rich and fertile land which lies idle. If it is put to some productive use its product would be great. Therefore the loss is great when it is idle.

One section of the leisure class consists of the retired farmer or the retired business man. Fortunately, in this country the retiring habit is not so general as it is in older countries. Our business and professional men of conspicuous talent are more inclined to keep at it than are similar men in older countries. This is greatly to our advantage, as we are therefore better supplied than we would otherwise be with human energy of a high grade actually at work.

There is a story in wide circulation, with such variations as suit the locality, of a farmer, usually an Indiana farmer, whose chief ambition in life was to grow more corn to feed more hogs, to buy more land to grow more corn to feed more hogs, etc. No one with a well-developed sense of humor is supposed to require an explanation to enable him to see the joke. It seems so futile to spend one's life growing corn and hogs in order that one may grow more corn and hogs that, aside from the tragedy of such a wasted life, it seems positively funny—that is, until one stops to ask one's self what there is funny or absurd about it. Then one begins to be haunted by the suspicion that the joke may be on the teller of the story and not on the farmer. Possibly the farmer was functioning as a very useful member of society; possibly he was more useful even than any of those humorists who have repeated the story about him. If so, is not the joke reversed?

It might be difficult to convince certain high-browed idealists that growing corn and hogs is useful work; but I have known several who showed a liking for breakfact bacon, and would have registered pained surprise if their supply had not been forthcoming when they casually appeared at the breakfast table at a late hour in the morning. Now, it is not necessary that a high-browed idealist should be either well informed or consistent; but if he were well informed he would know that corn and hogs are necessary to the production of breakfast bacon, and if he were consistent he would not affect to despise the humble producer of his breakfast. However, it is quite conceivable that our high-browed idealist may not despise the production of bacon as such, but that he may think that the farmer should not make that his chief ambition. Then the question would arise as to whether we are likely to have as good

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bacon or as efficient production of corn and hogs by men who think poorly of their work as by men who make it their chief ambition. In almost every other field it is generally assumed that we get better results when men specialize and give their lives to the mastery of one trade or occupation. Why, then, should we withhold our admiration from the man who chooses the growing of corn and hogs as his life work and devotes his life to it—that is, assuming that corn and hogs are useful products? Our idealist's objection, however, may be on the ground that the farmer should have spent a part of his time at least in cultivating idealism in himself. This, I shall maintain later, is precisely what, in the terms of the story, that farmer was doing in the best possible sense.

Another type of man, with no great disposition toward any kind of idealism, but with a strong desire for his own amusement, would probably criticize that Indiana farmer because he wasted his time in producing wealth which he never took time to enjoy. If, instead of continuing in business, he had retired, he might have spent the latter part of his life in ease and comfort—perhaps in a moderate degree of luxury. At any rate he could have avoided work. Since men who reason thus probably outnumber the high-browed idealists, it is probable that it is this aspect of the case which appeals to the average sense of humor when the example of that farmer is cited. Wealth is so obviously intended for consumption that it seems absurd for a man to go on producing after he has accumulated more than he can consume. Since we are in the world for the purpose of having a good time, to get as much as possible out of the world rather than to put as much as possible into it, no one with any sense of humor could help laughing at that farmer. One may remark, parenthetically, however, that no great religious or moral teacher ever had that kind of a sense of humor, for none of them ever said that we were here for a good time, or that it was our purpose to get as much out of the world as possible. They have even gone to the absurd length of suggesting that we should put as much into and take as little out of the world as possible, which means literally that we should produce or serve as much as possible and not stop serving in order that we might consume.

There is a story of another farmer who did precisely what the average man probably thinks that Indiana farmer ought to have done. After he had prospered and builded his barns larger in order to hold his produce, he desired to retire from business and enjoy his well-earned competency. That is, he remarked to his soul, "Soul, take thine ease; thou hast much goods laid up for many years. Eat, drink, and be merry." But, strangely enough, this story, which may be set over against that of the Indiana farmer, was not told for the purpose of furnishing an example for us to follow. In fact, one of the principal teachings of the teller of this story was that men should continue to produce—that is, serve—and not give themselves over to useless consumption, which is self-indulgence. He certainly would not have appreciated the humor of the story of that Indiana farmer. Perhaps, however, he lacked a sense of humor.

Of course, corn and bacon are commonplace, and their production is a more or less plebeian occupation. Still another story might be told of a certain great artist, Michelangelo by name, who, in another field of production, worked all his life with a kind of demoniac energy. There is no evidence that he ever showed any inclination to slow up, to retire from work in order that he might consume his earnings. Somehow we do not speak of him as having wasted his life in mere work when he might have had a good time, nor do we think it particularly funny when we hear how he kept on working even when he might have enjoyed elegant leisure and graceful consumption. To be sure, Michelangelo was a genius and that Indiana farmer was not; but the fault of not being a

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genius is very widespread. If that be an unpardonable sin, few of us will ever be saved. Most of us, in fact, will have to be content with some commonplace or plebeian occupation. We may lay unction to our souls if it is as useful as producing corn and bacon.

When we find a great genius working all his life, getting more joy out of his work than he could possibly get by stopping to consume his earnings, none of us is so irreverent as to make a joke of it. Is there any reason why a lesser mind should not get joy out of a lesser work, even the producing of corn and hogs? In short, should not the same general rule of action govern the genius and the plodder? If it would have been a great loss to the world if a Michelangelo or a Thomas A. Edison had stopped working in order to "loaf and invite his soul," is it not with equal certainty a loss to the world, though a smaller one, when a commonplace man stops a humble though useful work for the purpose of self-cultivation or self-amusement?

The writer desires to take up the gauntlet as the champion of that Indiana farmer, and to maintain that he illustrates precisely what every man is in duty bound to do, whether he be an inspired producer of works of genius or a commonplace producer of plebeian products. There is no higher ideal of conduct than to keep on producing as hard and as long as one can, provided one is producing that useful thing for which one is best fitted. It has never been suggested that that Indiana farmer could produce anything better than corn and bacon. If so it would be a different story. Somebody must produce corn and bacon so long as we need them. The more efficiently farmers can be induced to work, the better the world will be supplied. The more farmers there are who follow the example of that Indiana farmer the better corn and bacon we shall have; the more there are who follow the example of that other farmer who said, "Soul, take thine ease," the poorer farming we shall have, and the poorer our supplies of corn and bacon. What has been said about farming applies equally well to every other occupation, from that of the most transcendent genius to that of the humblest laborer. Show me a community where this ideal prevails and I will show you a prosperous, a progressive, and even a cultured community. Show me a community where the opposite ideal prevails and I will show you an unprosperous, a decadent, and, in the end, an uncultured community.

It will be remembered that that farmer who after having builded his barns bigger decided to retire from business had joined the leisure class. Now, I maintain that where that is the normal ambition of all men throughout the community, the result will be that the highest and most productive talent will go most to waste. * * * The most successful farmer would be the one who would earliest acquire a competency and who would, therefore, retire from business earliest in life and waste in unproductive living the largest portion of his potentially productive life. The less competent farmer might have to work all his life, for the simple reason that he never could accumulate a competency. The same would apply to the business man and the professional man. The very men who, in the interest of the community at large, ought to remain active, are encouraged by this false ideal to become inactive, and the men whose activity is least valuable to the community are the men who would be compelled by necessity to keep on working. We must conclude, therefore, that its fund of human energy is not only the most precious possession of any community; but also that a general and widespread desire for leisure is a means of wasting the most precious portion of that fund. In order to avoid this we must cultivate the productive ideal. We must uphold the idea that because a man is preeminently successful in any kind of useful work is the greatest and

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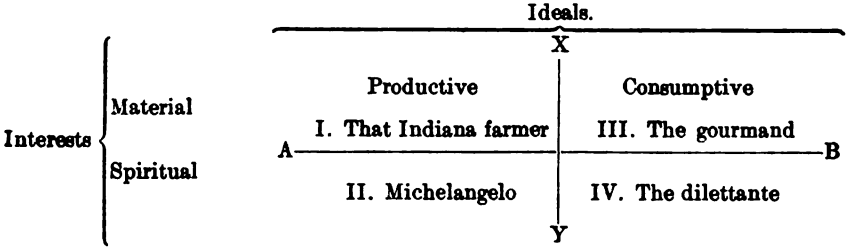
most cogent reason why he should keep on working: he is the man most needed. If that Indiana farmer was a successful grower of corn and hogs, that was the very reason why he should have kept on growing corn and hogs. If he had been unsuccessful, there might have been some reason for encouraging him to retire from business.

The carnal mind, however, is so prone to the opposite theory of life that this proposal will seem revolutionary. What is wealth for except to consume? When one has builded one's barns larger, why should not one say, "Soul, take thine ease"?

In certain low states of civilization it has been observed that the only way to keep laborers at work is to pay them low wages, keep them in debt, or keep them poor in some other way. If, for example, a laborer in that civilization can earn enough in three days to keep him for seven, he will work only three days a week. Whereas if it takes six days' wages to supply his needs for a week, he will work six. This principle of conduct, however, is not confined to southern negroes and Mexican peons. It shows itself in different forms in different places, but the principle is the same. If a man can earn enough in 4 hours to keep him for 24 hours, he will sometimes work only 4; that is, he will go to his office at 10 o'clock a. m. and work till 2 p. m., and then play golf or go to his club for the rest of the day. Or, if a man can earn enough in 20 years to keep him the rest of his life, he will only work for 20 years; that is, he will retire from business and spend the rest of his life in self-enjoyment. Will anyone undertake to maintain that there is any economic or moral difference between the attitude of the laborer who works only three days a week because he can earn enough in that time to keep him the whole week, and the business man who works only four hours a day because he can earn enough in that time to keep him the whole day, or who works only 20 years because he can earn enough in that time to support him for the rest of his life? They who see so much humor in the story of that Indiana farmer are asked to ponder this question very carefully, but they are asked not to confuse the man who retires from business in order that he may work equally hard at some other and more useful occupation with the man who retires merely to indulge in the passive enjoyment of using up his accumulated wealth.

A particularly erroneous ideal permeates our so-called cultured or highly-educated classes. This ideal emphasizes the distinction between material and spiritual interests, with the consequent tendency to despise material products and those who produce them, and to evaluate only the products of the spirit and those who produce them. There is another distinction which is very much more important than this and which cuts straight across it. That is the distinction between the ideal of production and the ideal of consumption. One's production is one's contribution to the world. One's consumption is one's subtraction from the world. These two distinctions may be visualized by the following diagram:

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In this diagram the line AB we will assume represents the division between material and spiritual interests, whereas the line XY represents the distinction between the productive and consumptive ideals. The crossing of these two lines makes four compartments in which we may place people of varying characteristics. One may have a productive ideal of life, but his field of production may be material rather than spiritual. This would place him in the first compartment along with that Indiana farmer. One may also have a productive ideal of life, but one's field of production may lie within the spiritual zone. This would place him in the second compartment along with, let us say, the Michelangelos. On the other hand, one's ideal may be that of a consumer and his form of consumption may be material. One then belongs in the third compartment along with Falstaff or that farmer who "builded his barn bigger" and then retired from business. Again, one's ideal of life may be consumptive, but his field of consumption may lie wholly within the spiritual zone. This places him in the fourth compartment along with such spiritual Sybarites as the aesthete who regards it as his chief mission to "loaf and invite his soul." Now, it is the contention of the present writer that the line XY is very much more important than the line AB; in other words, that the distinction between the productive and the consumptive ideals of life needs very much more emphasis than does the distinction between the materialistic and the spiritual zones of action. Moreover, it is his contention that there is a strong tendency among the so-called cultured and highly educated to emphasize the line AB rather than the line XY, and that this tendency is vicious and should be combated. Because that Indiana farmer is found on the productive side of the line XY, it is contended that he is an idealist in the true and proper sense.

The habit of retiring from business as soon as one has accumulated a competency has the peculiarly disastrous effect of wasting the talent which is scarcest and most needed. The more valuable an individual's talent the sooner on the average and in the long run will he be able to accumulate a fund of wealth to support him during the rest of his life. The earlier, therefore, he will be able to retire, and the greater portion of his life will therefore be wasted. I have in mind, for example, a great surgeon whose knowledge and skill have blessed large numbers of people. He was so successful and so much in demand that he could easily have retired from active work years ago. He is the sort of man which society can least afford to spare. If he were less skillful and less successful, it would be no great loss if he should retire from active work. Because his skill is so scarce and so precious, it is a great loss if it is allowed to go to waste.

Again, it may be said that there is a difference between the work of the genius and that of the plodder; that the growing of corn and bacon does not appeal to the imagination as does the healing of the sick. Yet it is useful work, and the same principles of conduct should apply to both. This economic principle which we all see with such clearness when applied to the work of the great surgeon applies equally well to the work of all; and it is doubtless this economic principle which was in the mind of the teller of the story of the farmer who builded his barns bigger and then retired from business.

The case of the great business organizer, the successful investor, and the captain of industry ought to be quite as clear in principle as the case of the great surgeon. Is it not clear that the more successful investors we have and the more great captains of industry we have, the greater will be our industrial expansion? The larger the number of productive enterprises which are started and run successively, the larger the number of laborers who will be required to man these establishments. Unless the supply of labor increases correspond-

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ingly, this increase in the demand will tend to raise wages and to give employment to the employables who are now unemployed.

If it were the habit of these captains of industry and successful investors to retire from business as soon as they were financially able to do so, the result would be that the best men would retire at the earliest age, leaving the less successful men to bungle along simply because they were never able to accumulate enough to enable them to retire. This would mean a less successful administration of our affairs, fewer successful business establishments, less demand for labor, lower wages, and more unemployment.

Enough emphasis has never, I believe, been laid by any economist on the principle of "joint demand," as Marshall calls it, or "complementary goods," or "noncompeting groups." With respect to commodities, we are all familiar with the fact that frequently the supply of one commodity creates the demand for another, whereas the lack of one commodity may destroy the demand for another. This holds true wherever several different commodities have to be combined in the production of the same result. In order to make gunpowder, for example, it is necessary to have charcoal, saltpeter, and sulphur in certain fairly definite proportions. If it should happen in any community that there was an abundance of charcoal and a scarcity of saltpeter, a good deal of the charcoal would be unemployed or unused, at least in the powder-making industry. Charcoal would be going to waste primarily because there was not enough saltpeter to mix with it. Anything which would increase in that community the available supply of saltpeter would increase the demand for charcoal, assuming, of course, that there was a demand for gunpowder as a finished product. Anything which would still further reduce the supply of saltpeter would still further reduce the demand for charcoal. Under such conditions it would be natural and just that saltpeter should command a high price and charcoal a low price—a high price for saltpeter being society's method of calling forth a larger supply; a low price for charcoal being society's method of discouraging an oversupply. Now if, as a result of this, all the producers of saltpeter were so well paid and so desirous of leisure as to induce them to take advantage of their prosperity by retiring from business, things would go on from bad to worse. The higher the price of saltpeter the more prosperity to the producers of saltpeter; and the more prosperity the earlier they would retire from active business. The retiring habit would, in that situation, be a serious interference with the process of readjustment.

Precisely the same principle applies to labor as to commodities. It frequently happens that different kinds of labor have to be combined in the production of a given commodity. Spinners and weavers, for example, are both necessary in the production of cloth. If we could imagine a situation where there were many spinners but few weavers, the scarcity of weavers would limit the demand for spinners just as effectually as the scarcity of saltpeter in the foregoing illustration limits the demand for charcoal. Anything which would increase the supply of weavers would increase the demand for spinners; and, vice versa, anything which would diminish the supply of weavers would diminish still further the demand for spinners. It is true that men can be taught new trades, and therefore an oversupply of spinners could be relieved by training more weavers. But when we consider occupations which require vast differences in skill and training the process is not so easy. I was told recently of a glass manufacturer who desired to develop a new branch of his industry. In order to do so he required one or two men with a highly specialized technical training. He tried to find these men and offered as high as $22,000 a year salary. He failed to find them. As a result of this failure he did not enlarge his establish-

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ment. Therefore he did not give employment to several hundred men to whom he would have given employment had he been able to find these two men with a high degree of technical skill. Here was a case where scarcity of one kind of skill reduced the demand for other kinds. The operation of the principle is just as clear and concise in this case as in the case of the charcoal and saltpeter.

There is no reason to believe, however, that a scarcity of this particular kind of skill is due to the retiring habit. It is due, rather, to the lack of specialized technical training—in other words, to ignorance. Ignorance here, however, is used not in the sense of a crass and degraded state of mind, but merely in the sense of a lack of knowledge. The problem of ignorance will be discussed later.

The importance of the function of the investor in the economy of the productive power of a community is seldom fully appreciated. To understand this function thoroughly we should go back to some of the elementary facts of economics. In the first place, the investor is a buyer of producers' goods as distinguished from consumers' goods. The investors' market is a place where producers' goods are bought and sold in the same sense that the consumers' market is a place where consumers' goods are bought and sold. When many people are buying on the investors' market it means that there is a great demand for producers' goods. The choice of the buyer is about the most elementary fact in determining the general direction of industrial development. If I have a dollar to spend and choose to spend it for confectionery, I increase the demand for confectionery to the extent of a dollar and to that extent tend to call the productive energy of the community into the confectionery industry. Whether it be a dollar or a million dollars, the principle is the same. If instead I had decided to spend that dollar for millinery, I to the same extent should have called the productive power of the community into the millinery industry. If, instead of spending my money for confectionery or millinery or any other consumable article, I had chosen to spend that dollar for some kind of tool, say a spade, I should have directed the productive energy of the community into the tool-making or spade-making industry. When I choose to spend my dollar for tools rather than for consumers' goods, I become an investor. The more people there are who become investors the greater the demand for producers' goods and the larger proportion of the productive power of the community is turned to the tool-making industry or the industries which build productive enterprises.

Carrying out the same method of analysis we see that a great deal depends upon the kind of tools which I choose to buy with my dollar, or with my million dollars, if I had that many. To invest in tools that do not happen to be needed is not only to waste my money but to waste the productive power of the community. Money which is spent by investors for a given kind of producers' goods directs the productive power of the community into that particular line. And if the products are not needed, then all that productive power is gone to waste. An unskilful investor is therefore a very wasteful factor in society. Conversely, a skilful investor who makes no such mistakes, who always buys producers' goods which are needed, is one of the greatest conservers of human energy which any community possesses. A genius for investment may be less spectacular than a genius for invention; but it is, if there is any difference among geniuses, the more important of the two. Unless investors are born and not made we must assume that it is possible to train investors if we can only discover the right educational method. A school of business which would really train not only captains of industry but successful investors would probably do more for the conservation of the productive power of the nation, and also for

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the improvement of the wages and the conditions of living of the laboring classes, than all the radical programs of social reform that were ever invented. Much can doubtless be done to prevent wasteful investment by legal restriction. Probably the Kansas blue-sky law, if it can be made constitutional and effectively enforced, is one of the most constructive pieces of legislation that have been enacted in this country since the legislation which came at the close of the Civil War. The facility with which unskillful investors are persuaded to waste their money in bad investments seems to call for some kind of legislative protection. The kind of legislative protection which will protect these unskillful investors against the results of their own stupidity may seem somewhat sentimental; nevertheless we can not deny that a vast quantity of capital which might float into productive industries is thus squandered and misdirected, and that this misdirection not only wastes the money of the stupid investors (which is the least of the evils connected with it) but it tends to divert the productive power of the community into wrong channels, which is a matter of much more consequence.

Another cause of the waste of human talent, as things now work out, is found in the institution of inherited wealth. They who join the ranks of the leisure class or the voluntarily idle are less likely to be the individuals who themselves have accumulated a fortune and retired from active work than their descendants of the second or third generation. In order to consider this phase of the problem it is not necessary that we assume any attitude either friendly or hostile toward inherited wealth as such. The writer certainly has no grievance against those who are living on inherited wealth. They are not depriving him of anything which is his or which he has earned. But the fact can hardly be disputed that the individual who lives in idleness is going to waste. If it is inherited wealth which enables him to live in idleness, it is inherited wealth which causes him to go to waste. The present writer has elsewhere classified wealth as consisting of earnings, stealings, and findings. The fortunate possessors of wealth which is merely found and not stolen, such as inherited wealth which comes to one through the accident of birth, are not in any sense reprehensible, nor has anyone else a real grievance against them. But the question is not one of grievances. The question is one of the economy of human talent or the conservation of human energy.

Whenever it becomes a general observation that inherited wealth is made, more frequently than not, the means of enjoying leisure, or, in other words, of wasting human talent, it will then be time to consider seriously the question of abolishing or of limiting inheritances. So long as the possessors of inherited wealth continue to use their talents productively no possible harm can result and there would be no reason for an agitation for the abolition or limitation of inheritances.

In times past, before the outbreak of the present European war, we Americans were in the habit of thanking our stars that we were not compelled to support vast standing armies or to waste two or three years of the productive period of young men's lives in unproductive military service. All this time we needed to be reminded that we were very dark pots engaged in the pastime of calling kettles black. It is not at all improbable that these same young men would acquire discipline which would more than compensate for the time spent; that is to say, during the total lifetime of the average man he may have been able to contribute more to the national wealth and progress by reason of those three years' discipline than he would have been if he had not had them. While we have maintained a smaller standing army than European nations, the general rowdyism and ineptitude which characterize our people are topics

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on which we have not cared to speak. Even if we never needed an army, it is not improbable that it would be a good thing for us to have compulsory military service for the sake of the discipline which it would bring with it, provided, of course, we could not find another means of discipline which would answer the purpose equally well.

Again, we have not cared to expand much upon the fact that we support more lawyers than any other country. If international war is wasteful, so also, in a lesser degree perhaps, is private litigation among the citizens of the same country. We have to support not only an army of lawyers but to waste a great deal of other valuable talent in these unprofitable litigations.

Coming to the subject of ignorance, we have to charge it with a vast amount of wasted human talent—that is, of talent which goes to waste because it is imperfectly employed. We have men who are compelled to do a lower grade of work than they might otherwise have been able to do had they been properly educated. He who is compelled by circumstances to do a less useful work when he might have been doing a more useful work, is going to waste in part at least. He is like a Raphael painting a barn or a Beethoven playing a mouth organ. There is a very close analogy between a sound educational policy and a productive industry. All industry, as was pointed out long ago, consists in moving materials from one place to another. Back of this process of moving things from one place to another is a fact which does not appeal to the physical eye, namely, that we are moving things from places where they are useless or less useful to places where they are useful or more useful; and other things from places where they are harmful or more harmful to other places where they are useful or less harmful. This implies, in other words, that in any time and place in which a man finds himself there are some things which are too scarce and others which are to abundant for his comfort. He must immediately set to work readjusting things, and this readjusting takes the form of moving things. Of any great society the same is equally true. It finds itself in the presence of some things which are too abundant and must, therefore, be thinned out; it finds itself in need of other things which are scarce and must therefore be increased in quantity. All industry is directed toward these ends.

Our whole process of valuation, whether it be in the commercial, the moral, or the intellectual field, is determined and directed by this primordial situation. Anything, whether it be a material commodity, a moral quality, or a mental attainment of which the community can say that it would be better off if it had more of it, is highly esteemed; that is to say, is valued. Anything, on the other hand, of which the community can say it would be better off if it had less of it, is disesteemed. This also is true whether the thing in question be a material commodity, a moral quality, or a mental trait. The purpose, therefore, of industry is to diminish the things which are disesteemed (that is, the things of which the community feels that it has too much or of which it says it would be better off if it had less) and to increase the things which are scarce (that is, the things of which it feels that it would be better off if it had more). Similarly, the purpose of morals and religion is to decrease those moral qualities of which the community feels that it has too much or that it would be better off if it had less, and to increase those moral qualities of which it feels a scarcity, or that it would be better off if it had more. Following this parallelism a step further, we may say that the purpose of all education is likewise to diminish those mental traits, tendencies, or capacities of which we seem to have too much, and to increase those of which we seem to have too little. This



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is the great law of economy in all fields of endeavor, and it brings commercial valuation, moral valuation, and mental valuation under one and the same law.

The correct theory of education is embodied in the inscription on the west gate of the Harvard yard: "After God had carried us safe to New England and we had builded our homes, provided necessaries for our livelihood, reared convenient places for God's worship and settled the civil government, one of the next things we longed for and looked after was to advance learning and perpetuate it to posterity, dreading to leave an illiterate ministry to the churches when our present ministers shall lie in the dust."

It will be noticed that nothing is said about the dread, lest some young men should fail of self-realization, or lest they should fail to get the most out of life. It indicates, on the other hand, that the founders of Harvard felt that there was a distinct social need. After the present ministers should lie in the dust there would be a scarcity of the kind of talent which they regarded as very necessary. In other words, the institution was created to train men for what they thought to be a genuine social need; to make the kind of talent abundant which would otherwise be scarce. Whether we agree that their diagnosis was right or not—that is, even though we reject the idea that the colony did need ministers—still we can hardly afford to reject their theory of education—namely, that it was intended to supply the kind of ability which society needed. It must have been apparent to these founders that every time a man was trained for the ministry there was one less man for some other job. Still, this would not have deterred them if they had felt that they would train men out of less useful into more useful occupations. Any educational system, on the other hand, which professes merely to give men a gentlemanly appreciation of the ornamental things of life, or to train them in order that they may get the most out of life, or to give all-round self-development without much regard to what society needs, is necessarily a perversion of all sound educational theory.

The redistribution of human talent is a phrase which comes as near summarizing a sound educational policy as any single phrase can. Of course it requires further explanation and qualification. To redistribute human talent without regard to social needs would possess no merit whatever; but the redistribution of human talent with respect to social needs is a summary of all the law of the prophets so far as education is concerned. The ideal which probably can never be attained, but which may be approximated, is such a redistribution of human talent as to make all kinds of talent about equally abundant in proportion to the social needs. If we could bring it about that hand laborers were so scarce and business managers so abundant that the community would gain or lose about as much by the gain or loss of a single hand laborer as it would by the gain or loss of a single business manager, then we would have the ideal redistribution of human talent. Incidentally, of course, we should have an ideal distribution of wealth because one kind of talent would be approximately as well paid as another. As I have said before, this ideal condition can be approached, however, only by training men out of, or away from those occupations where men are abundant into those where men are scarce.

Ignorance can hardly be defined in absolute terms. The barbarian, the savage, or the backwoodsman, possesses a wealth of knowledge which the modern academician lacks altogether. The unskilled laborer possesses a skill and technique which is unknown to his employer. He who possesses a kind of skill or technique which is oversupplied is called an ignorant man; he who possesses a kind of skill or technique which is undersupplied or scarce is called an educated or a trained man. Ignorance is, therefore, a relative term. It

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means a lack of the kind of knowledge which is scarce at the time and place under discussion.

Here, again, we must be on our guard and remember that it is always a question of more or less. More accurately, therefore, we should say that ignorance is a lack of that kind of knowledge of which society feels that it wants more than it has got. This may involve the possession of another kind of knowledge of which society does not feel that it needs much more than it has got. However much of this kind of knowledge one possesses, one will still be classed as an ignorant man, and properly so, because he is not equipped with the kind of knowledge which would enable him to function as an indispensable or even highly useful member of society.

Generally speaking, he is the greatest man who happens to possess the kind of knowledge which makes him the most nearly indispensable to the rest of the community. In a military régime, the indispensable man is the man who knows how to manoeuver armies so as to win victories. The presence or absence of such an individual may make all the difference between national glory and national shame. One man more or less of the kind who know how to fight in the ranks, or to handle the implements of warfare, may make very little difference. One man more or less who knows how to manoeuver armies may make all the difference in the world. In an industrial régime it may easily happen that the captain of industry is one of the most indispensable of men.

He who can devise educational systems and educational methods which will increase noticeably the kind of talent of which there is a felt scarcity, and diminish the kind of talent of which there is a felt superabundance, is one of the greatest conservers of human energy that any country can possess. He deserves to rank ahead of the statesman, the business manager, or even the investor. Generally speaking, his work consists primarily in training men for skilled work who would otherwise be compelled to do unskilled work; to do mental work who would otherwise be compelled to do physical work; to do work requiring judgment and discretion who would otherwise be compelled to do routine work; to do work requiring courage and initiative who would otherwise be compelled to work under direction.

There is doubtless much bad distribution of wealth which is due to exploitation and injustice. The present writer will go as far as anyone in the effort to remove these causes of bad distribution. However, he is distinctly of the opinion that the bad distribution of wealth is mainly due to the bad distribution of human talent, and that the most constructive program for improving the distribution of wealth is an educational program for improving the occupational distribution of human talent.

There is another sense in which ignorance is a great waster of energy. This may be called a kind of social ignorance, ignorance of real values, ignorance of the best methods of working together. One form in which this ignorance sometimes expresses itself is in the contrast sometimes drawn between human rights and property rights. It does not require a great deal of intelligence to see that all property rights are human rights. Things have no rights; human beings have rights in things. And these rights in things are sometimes called "property rights." Where these human rights in things are clearly understood and wisely safeguarded, you have some of the most important features in social prosperity. Wherever property rights are respected, there you find better conditions, other things equal, than you find in communities where property rights are not respected. Where property rights are respected you find conditions which attract people away from communities where property rights are not respected. Unless there be free land or great undeveloped natural

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resources people do not immigrate into a community where property rights are disregarded. Communities which are approximately of equal age, with approximately equal opportunities, can almost be classified on the basis of the efficiency of the protection of property rights. Where property rights are not respected and safeguarded, there is little prosperity, and the people in order to find employment, must leave such a community and go to another community where property rights are respected.

Instead of attempting to contrast human rights with property rights, which is no contrast at all, there might be a real question as to the relative importance of human rights in certain kinds of property and human rights in certain other kinds of property; or human rights in property as compared with human rights that have no relation to property. These contrasts would present intelligible questions which could be discussed by rational beings. The other contrast can not be discussed because there is no question stated.

Ignorance with respect to the nature of human conflict, particularly as to the nature of the different forms of economic competition, is responsible for a good deal of waste. Of all forms of human conflict, that which is known as economic competition is the highest. In no other form of conflict does success depend so much upon productivity or service, and so little upon destruction and deception. There are three kinds of economic competition—competitive production, competitive bargaining, and competitive consumption. Competitive production always works well, competitive bargaining sometimes works well and sometimes badly, while competitive consumption always works badly. Competitive production is, therefore, the highest form of economic competition, as competitive consumption is the lowest form, while competitive bargaining occupies a middle position. Competitive consumption has to do with private life rather than with business; therefore, it lies outside the field of our present discussion.

We include under the word production any handling of materials which renders them more usable or useful. Thus, even the retail mercantile house stores goods, thus adding to their time-utility. It receives them in large lots, such as are convenient for the producer to sell, and hands them out in small lots, such as are convenient for the purchaser to buy, and, finally, it sometimes delivers goods to the customer, thus adding to their place-utility. All this is productive service. But, in rendering this service, it must buy and sell. Here skill in bargaining counts. Even the farmer, whose work is generally assumed to be mainly productive, must do a good deal of buying and selling, borrowing and lending. This calls for skill in bargaining. Every legitimate business, in fact, is made up of two parts, one of which may be called producing and the other bargaining. In some lines of business success may depend primarily on skill in production, but it will always depend to some extent upon skill in bargaining. Other lines of business there are where success depends primarily upon skill in bargaining, but always, unless it is an absolute swindle, to some extent upon skill in production.

Many of the supposed economies of large scale business turn out, upon examination, to be advantages in bargaining rather than economies in production. If the large concern can control a source of raw materials and thus get them on more favorable terms than it will allow its smaller rivals, it may beat the latter in competition, but its success is, in that case, due to superior bargaining power rather than to more efficient production. The large concern may succeed in getting better transportation rates than the small concern, but this is superior bargaining power rather than superior producing power. Again, it may be able to handle the labor situation in such a way as to gain an advan-

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tage in hiring its labor, but this also is a form of bargaining power rather than a form of producing power. Finally, the large concern may be able to maintain a better selling organization, or to advertise more lavishly than a small concern. This, like the others, is an advantage in bargaining rather than in production.

There is in almost every line of business a certain size which gives the maximum efficiency in production. How large the size should be depends upon a variety of circumstances of time and place. There is also a certain size which gives the maximum efficiency in bargaining, that is, in buying and selling, borrowing and lending. As a general rule, the size which gives the maximum efficiency in bargaining is larger than the size which gives the maximum efficiency in production.

This has a very important bearing upon the problem of agricultural development. The most efficient producing unit is the one-family farm; that is, the farm which supports one family, and cultivated by the labor power of one family. It should, of course, be a farm large enough to occupy the full-working time of the family when equipped with the best teams, tools, and general equipment which are available. Man for man, or in proportion to the total number of persons engaged, this is the farm which gives the highest average product as distinguished from profits. Under normal conditions, this type of farm will hold its own in competition with all others. But under abnormal conditions, it may be beaten out.

Where the large farm has some special advantages in securing a cheap supply of labor, such as slave labor, coolie labor, or masses of immigrant labor, the large farmer may beat the small farmer in competition. The latter, having to sell the product of his own labor in competition with the products of this cheap labor may be run out of business, or reduced to a condition of poverty. This, however, is an advantage in bargaining. They who work on the land sell their labor at so low a price, or, in the case of slaves, their labor costs the owner so little, that the large farmer may make a large profit in spite of the low average productivity of the persons engaged. The worst and most dangerous enemy of the small farmer, therefore, is he who tries to foist upon the rural districts a large supply of cheap labor. This is designed to give the large farmer an advantage in purchasing his labor. It will force the small farmer to sell his own labor, or its products, in competition with that cheap labor, to his own impoverishment or extinction.

Again, in buying his supplies, in selling his products, especially if they be perishable, the large farmer usually has an advantage. Cooperation among small farmers, however, may give them the same advantages in buying and selling which is otherwise the exclusive possession of the large farmer. The small farmer of the present day is the only large class which regularly buys its raw materials at retail and sells finished products at wholesale. In the borrowing of capital, likewise, the small farmer is usually at some disadvantage. This, likewise, can be overcome by collective bargaining, or cooperation.

We need not indulge in any poetic rhapsodies over the small farmer. If he is inefficient he must go. But we should be very careful to diagnose his case and find out where his inefficiency lies. It seems that he is efficient in production, but inefficient in buying and selling. This inefficiency can be overcome by the organization of small and efficient producing units, into large and efficient bargaining units. Organization, therefore, should be the watchword of the small farmers of the next generation.

Before leaving the subject of agriculture it ought to be pointed out that much of the advocacy of intensive agriculture is misdirected and calculated to

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waste human energy—that is, labor—while trying to economize land. It often happens that the most economical use of one factor involves a necessary waste, or uneconomical use of another. If the one is dear and the other cheap, this is good economy. The intensive use of land means the application of so much labor and capital to its cultivation as to approximate the maximum product per acre. This involves, in almost every case, a low product per man, or per unit of labor employed in its cultivation. So generally is this the case that it is almost a rule, taking the world in general, that intensive agriculture and poverty go together. That is to say, wherever agriculture is carried to a high degree of intensity you find, as an observed fact, that the workers on the land are poor. The reason is not far to seek. Where land is so highly cultivated as to bring it to its highest productivity it is because a great deal of labor is combined with very little land. But this means that each unit of labor has very little land on which to work. An intensive use of labor, such as will give it the highest productivity per unit, requires that it shall have an ample equipment, not only in the form of good and abundant tools, but also of good and abundant land. But when each unit of labor is abundantly supplied with land, each unit of land can not be abundantly supplied with labor. As between the two, it is more important that each unit of labor should produce its maximum than that each unit of land should produce its maximum. In other words, an intensive use of labor is very much more important than an intensive use of land.

Very closely related to the question of intelligence as an economizer of human energy is the factor of mutual confidence. One of the greatest factors in the economy of effort, otherwise called the saving of labor, is confidence. Its greatest value is not found in the stability which confidence brings to the financial market, though this is very important. It is even more important in its effect upon the foundations of the economic structure of which the financial market is the apex. Nor is its greatest value found in the unshackling of enterprise which results from confidence in the Government, though this is of tremendous importance. So important is this that it is generally conceded by students that even a bad system of laws, provided they be enforced with certainty, regularity, and precision, may be better than a good system when enforced with uncertainty, irregularity, and lack of precision. In the former case, the citizen knows what to expect and can adjust his plans to the situation. In the latter case, he never knows what to expect, nor how to lay his plans. Of course, a combination of a bad system of laws with an irregular and uncertain administration is vastly worse; but the point is that confidence in the regularity and calculability of the Government is of the utmost importance. The average citizen has more points of contact with his fellow citizens than he has with the financial market or even with the Government itself, and the sum total of the dealings among individual citizens exceeds not only in number but also in the sum total of importance the dealings with the financial market and the Government. It is in these multifarious relations between man and man that confidence assumes its greatest importance—where its lack results in the greatest waste of effort, or its presence in the greatest economy.

Prof. E. A. Ross in his book on The Changing Chinese mentions certain parts of China where the owner of a rice field must guard his crop every night to keep it from being stolen. The waste of energy involved in this process must be tremendous. Unless we have at some time been confronted with the same necessity, we can scarcely appreciate how much energy we save in being able to sleep at night in confidence that the products of our labor will not disappear

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before morning. But before we waste too much sympathy on those Chinese farmers we should consider the position of the fruit grower and the market gardener in the neighborhood of our large towns. Unless one is able to produce on a scale sufficiently large to permit one to hire a watchman, or unless one is very favorably situated with respect to police protection, one is at the mercy of town marauders. This injures the town consumers as well as the country producers, because it adds to the cost of growing fruits and vegetables, and the town consumer must share in the cost. The sheep grower has his troubles also with the sheep-killing dog, which adds to our cost of living by discouraging sheep husbandry. Until we can create conditions under which every farmer can go to bed at night in serene confidence that his property will not be stolen or destroyed before morning, we shall not achieve the maximum economy of effort.

But more important than safety from theft or destruction is the confidence of neighbors in one another which will enable them to work together for their common good. One of the greatest hindrances to cooperation is the lack of confidence which neighboring farmers feel in one another. The writer has talked with and to a good many hundred farmers on the subject of cooperation. He has found very few who doubted that it would be a good thing, but when he has tried to find out why they did not cooperate he has generally found that it was because of a lack of confidence in one form or another. Sometimes this lack of confidence is due merely to a feeling of uncertainty as to just how to begin. We are all of us afraid of the water until we have been in often enough to feel certain that we know how to swim. This lack of confidence should, perhaps, be called caution, which, up to a certain point, is a good thing. Frequently, however, it is due to a sheer lack of confidence in the integrity or good will of one's neighbors. Where this lack of confidence is justified by such lack of integrity or good will there is need of a moral or religious reform. The reformer who could create integrity, reliability, and good will, where these qualities do not now exist, should be ranked with the mechanical inventor or the engineer who devises labor-saving methods. Nothing could economize labor more effectively than the creation of these moral conditions which would enable the neighborhood to work together rather than at cross purposes. In some respects a neighborhood may be likened to a large and highly complicated machine. If the various parts are not working in harmony, but are banging against one another, there is a great waste of power and efficiency. It would not be stretching the meaning of terms very much to say that a highly immoral condition existed within the machine. In the social organism the harmonious working of parts is the essence of morality, and, conversely, the inharmonious working of parts is the essence of immorality. It is obvious that the cooperative organization of rural communities, so much needed for agricultural efficiency, is not to be created by merely saying "Go to now; let us work together." There can be no effective cooperation where there is no mutual confidence; there can be no mutual confidence where there is little integrity, reliability, or good will. In a community where every man's word is as good as his bond, where every neighbor can be relied upon to do his part faithfully in the upbuilding of the community, and where there is a neighborhood pride and patriotism and mutual good will among all the neighbors, there will be no difficulty in working together, which is the essence of cooperation.

The subject of vice has not generally been considered as a subject for the economists, but has been reserved mainly for the moralist. If vice could be defined in such a way as to divest it of all economic significance, this might be

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a justifiable neglect. But we should not then have a rational conception of vice. Vice is, after all, nothing in the world except waste of human energy. Nothing is vice except that which wastes or dissipates human energy, and everything is vice which does waste or dissipate human energy. This brings vice definitely within the scope of the economist's study. So-called vice—that is, conduct which is condemned by the conventionalities of society, but which is harmless in itself in the sense of causing no waste—is merely evidence of social ignorance as to the real content of vice.

Of all vices there is probably none which is so wasteful as drunkenness. Therefore, there is probably no vice which is so reprehensible from a rational point of view. There may be people who would dispute this and insist that there are other forms of vice which are more odious to themselves than drunkenness. However, if the question were put to them in a practical way, they would probably agree without knowing that they were agreeing to this proposition. If they had their choice between riding behind a locomotive engineer who was addicted to drunkenness, and one who was addicted to any other vice, which would they choose? If they were compelled to choose between a chauffeur who was addicted to drunkenness and a chauffeur who was addicted to any other vice; between switch tenders, train dispatchers, bank cashiers, drug clerks, or men in any other position of responsibility in our interlocking civilization who were addicted to drunkenness, or those who were addicted to any other vice, they would not hesitate as to the choice. In our moments of high spiritual exaltation, especially if we are in a talking mood, we may express more hostile opinions regarding those whose views on baptism, or predestination, or sexual virtue, or profanity, are wrong, than against those who are addicted to drunkenness; but in our practical choice we make no such mistake.

One of the most hopeful signs of the times is the way in which the great mass of the serious thinking people, though perhaps somewhat commonplace in their views, are taking hold of this problem. No movement of popular opinion of the present day has shown such steady, consistent, and widespread increase as the prohibition movement. Though it is opposed on the one hand by many of the so-called intellectual elite, and on the other by the so-called radicals in a social and political sense, still the great mass of the common people who are neither intellectually gone to seed nor windy radicals are definitely for it.

There is, of course, something to be said in favor of a fool killer which would eventually tend to rid the world of those unstable natures which succumb to the temptation to vice. Where the vice is one which affects the vicious individual alone, or even mainly, the argument is overwhelmingly in favor of allowing individuals free access to that form of vice; but a vice which so quickly destroys the individual's responsibility and his fitness for functioning in an interlocking civilization as does alcohol, is quite as likely to be a killer of the wise abstainer as of the unwise indulger. No one is safe where men in all sorts of responsible positions become so habitually irresponsible as do those addicted to the vice of alcohol. The restricting of this vice, or the closing of opportunity for it, is, therefore, as much for the protection of the strong members of society who can resist temptation as for the weak members who can not. One of the great dangers of modern society is the growth of a maudlin sentiment in favor of weakness rather than in favor of strength. What is sometimes called "the cult of incompetence" is becoming practically a religion with some people. Men can not resist temptation; therefore temptation must be removed from them. Men can not be self-supporting; therefore a state must care for them. This is sometimes called a "paternal" state. It should rather

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be called a grandmotherly state. To protect weakness against itself is to cherish weakness—to bid it be fruitful and multiply. To compel strength to sacrifice itself in the interest of weakness, beyond certain rather definite limits such as are involved in the domestic relations, is to discourage strength, especially if we show a positive antipathy toward the success which comes with strength.

So much has been written in a demagogic vein about "big business" that the idea is gaining ground that bigness is a crime. This is in line with another popular idea, namely, that it is the duty of the Government to protect the weak against the strong. In a crude and primitive society it might, perhaps, have been assumed that the strong man was able to take care of himself and that it was only the weak man who needed protection. It is to be hoped, however, that civilization has advanced beyond this primitive state. Even the strong man may find it cheaper to pay taxes for police protection than to try to furnish his own protection. Even the weak man may need restraint as much as the strong man. If there is anything which modern psychology has proved, it is that the average criminal is a weak rather than a strong man. He is mentally defective, incapable of taking care of himself and unable to control himself, therefore he must be controlled by the State.

In short, it is high time that we stopped talking about protecting the weak against the strong. That is quite as absurd as the opposite idea usually fathered upon the late Frederick Nietzsche, that the strong should be given a perfectly free hand to rule and exploit the weak. It is time to begin talking about protecting production against predation. Whether the productive individual be strong or weak, the State must in its own interest protect him. Whether the predacious individual be weak or strong, the State must equally in its own interest suppress him. If the individual is in part a producer and in part preying upon other people, that part of his work which is productive must be protected and rewarded and that part which is predacious must be punished. The State need not give itself the slightest concern over the question as to whether he is weak or strong; that would be a silly question anyway. But the question whether his activities are productive or predacious is a matter of the utmost concern.

The more individuals there are producing and the more each one produces the better it is for the State. The more there are preying upon other people, and the more successful they are, the worse it is for the State. The more prosperous a man becomes through productive effort, the more prosperous he makes the State. The more prosperous he becomes through predacious effort, the more he subtracts from the prosperity of the State. The millionaire or the billionaire who has earned his millions or his billions is a benefit rather than a menace. The man whose wealth is measured only in thousands or even in hundreds, if he has not earned his thousands or his hundreds, is a menace rather than a benefit. In other words, the size of the individual's fortune need not give us the slightest concern. It is the way the fortune was accumulated, and that alone, which needs to be studied. The more millionaries there are in the country, the better off the country is, provided each millionaire has earned his millions. The only rational limit which ought to be placed on the size of a fortune is the limit of a man's earning power, and that limit can not be named.

The best way of estimating the value of a man or his earning power is to find out how much he would be missed if he were to stop working or emigrate, or, more accurately, how much worse off the community would have been if he had never worked. How much less would the community produce without

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him than it can produce with him? If that would make a difference of about a dollar a day in the total production of the community, then he is worth about one dollar a day. If it would make a difference of one thousand dollars a day, then he is worth one thousand dollars a day.

How much an individual is worth in the community, or how much he would be missed if he were to leave the community, depends to a considerable extent on the question of how many other men there are just like him who are able and willing to do the kind of work which he is capable of doing. If there are thousands of other men ready to take his place and do the work just as well as he can, obviously he is not worth much, and the community could get along just about as well without him as with him. If there is no one else who can do the work quite as well as he, and the work itself is quite important, then the community would miss him if he were to leave. In other words, he is worth a great deal. This, of course, is not very flattering to men of the former type. They can outvote the men of the latter type, and if they are foolish enough to be deceived by political clap trap, they are very likely solemnly to vote themselves to be the real producers of the wealth of the country and to call the other man a parasite.

This would be about as wise as the policy of the old woman who threw clubs at her chickens because they were shy and would not come when they were called. If there is a kind of work which it is very important that the community should have done, and there are only a few who are capable of doing it, two things are fairly obvious: First, those few will be well paid, because each one is very much needed; second, there ought to be more such men in that community if they could be found or persuaded to train themselves for that kind of work. The way to encourage men to train themselves for that kind of work is to pay them well for it and honor them besides. The way to discourage them and to make such men still scarcer is to denounce them and call them parasites. If there is another kind of work for which there are thousands of men ready and capable, however important that work is in itself, no individual among those thousands is worth very much; that is, any one of them can be spared with no great loss. If a certain number of these men could be persuaded to train themselves for the other kind of work for which men are scarce, the community would gain. It would lose a certain number of men in an occupation where men can be spared with no great loss. It would gain an equal number in an occupation where men were very much needed and where each addition was a great gain to the community. The way to encourage men to make this transition is to pay them low wages in the overcrowded and high wages in the undercrowded occupations. But while the men in the overcrowded occupation are in a weak position economically, they are in a strong position politically, in that they can outvote the men in the undercrowded occupation. They are, therefore, under a strong temptation, if they are improperly led, to try to vote themselves favors and to vote against the interests of those in the undercrowded occupation.

The writer desires to emphasize still further what he has already said with respect to the investor. He is convinced that the most needed men at the present time in our industrial system are the wise investors. An investor is merely one who buys tools instead of consumers' goods. He who spends a dollar or a million dollars for consumers' goods virtually turns the productive energy of the community toward the production of consumers' goods to the extent of his purchase. He who buys tools to the extent of a dollar or a million dollars, similarly turns the productive energies of the community toward the production of tools to the extent of his purchase. Provided he was wise in his choice of

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tools, the world is a great gainer because of his purchase—that is to say, if he selects for purchase the kind of tools which are needed to set labor to work and to provide the necessaries of life, the investor is a great benefactor. If he is unwise in his choice and purchases tools which are not needed and can not be profitably used, he is a waster of the energies of the community. Nothing can be more important, therefore, than that there should be a good many wise purchasers of tools—that is, wise investors. The more such men there are, and the wiser they are, the more rapidly will our industries expand, the more employment there will be for labor, and the higher the laborer's wages will be. The fewer such investors there are, and the less wise they are, the less will our industries expand, the less employment there will be for labor, and the less will our people be supplied with the necessaries of life. Because there are so few really wise investors, and because so many more are needed than we have got, the few who are really wise in their purchases of tools become very prosperous. The cure for this is obviously not to attack them and make them still scarcer, but to encourage them and make them more abundant.

From what has already been said regarding the power of the purchaser to direct the development of industry it will be easy to infer that the purchasing habits of a community will have much to do with the economy of effort. To economize human effort in every other respect—that is, to organize industry on the most efficient basis possible, to eliminate wasteful conflict and create widespread confidence, and do everything else to increase productive efficiency—and do nothing to improve the habits of consumption of the people, all may come to naught. What would it profit a community to be able to produce vast quantities of cheap and tawdry articles, to reduce to the lowest possible limit the cost of filling our bellies with the husks that were intended for swine, or to have all the tools and capital that could possibly be used in the production of articles that merely gratify ephemeral and sensual desires? If we once understand that with a well-organized industrial system we can have practically anything we want, then the great question arises, "What shall we want?" We can have as fine a country as we want if we are willing to pay the price—that is, to give up some things which we may desire but do not need in order to have the things which make a great country. Any city can become as fine a city as it wants to become, provided it wants to become so sincerely enough to be willing to sacrifice the trifling interests which interfere. The people of ancient Athens could doubtless have worn slightly more expensive clothing and eaten slightly more luxurious food for a good many years if they had not chosen to adorn their city with those monuments which we now regard as the chief justification for the existence of that city. Because they chose rather to spend their money—that is, their time and energy—on these architectural monuments than on the pleasures of dress or the palate, Athens became a noble city. The people of the medieval towns could doubtless have enjoyed for a considerable period of time slightly more expensive clothing and slightly more luxurious food if they had spent their time and energy in producing these things rather than in producing those monuments to their religious faith, which the western world admires but thinks it can not reproduce.

So any American city, if it chooses to spend its time and energy on food and clothing, can enjoy for a good many years to come slightly more expensive clothing and slightly more luxurious food than it could have if it chose to spend that time and energy in the adornment of its streets, in the improvement of its sanitation, in the building of schools and libraries, art galleries and other monuments to its intellectual life. If our people care more for bread and cir-

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cuses than for anything else, then of course the productive energy of our people will be directed toward the production of bread and circuses. If they care more for permanent contributions to civilization, such as will justify their existence to future generations as the existence of the people of ancient Athens is justified to us, then the productive energy of the community will be turned in those directions.

Industrially efficiency will then be genuinely economical and need no further justification. This point of view is so important that one can hardly be patient when thinking of the neglect which the subject of the consumption of wealth has suffered at the hands of most economists. However, while the economists may have neglected the subject, they can not be charged with having actually perverted the subject as most other publicists and molders of public opinion have been doing. Those half-baked economists who are sometimes contemptuously referred to as "magazine economists" pretty generally teach the doctrine that a lavish consumption of wealth is a good thing, especially for the laboring classes. They point out clearly enough that to spend money freely for articles of luxury tends to give employment to men in the luxury-producing industries. What they do not point out is that money spent on luxuries can not be spent on other things; that it would give just as much employment to labor to spend money on architectural monuments as on millinery or delicatessen. Or, to take a more commonplace illustration, it gives just as much employment to labor to spend money for tools, brick, and mortar, steel girders, and other building materials, together with machines and implements, as it does to spend money for immediate self-gratification. The difference, however, is that in the case of the expenditure of money for permanent things, society has something left to show for their labor which was expended, whereas if money is spent for ephemeral pleasures, there is nothing left to show for the labor which was used up in the production of those pleasures.

The only sound conclusion which we can reach on this subject is that he who teaches the people to want the right things is as much a contributor to national greatness as is the man who organizes the industrial forces in the most efficient manner for the supplying of wants. Lest room be left for the fear that lowering the standard of living may reduce the intensity and strenuosity of our work, it only needs to be said that the desire for a bank account or a life-insurance policy may enter into one's standard of living and be as effectual in stimulating one to high endeavor as the desire for beefsteak or caviar; or, that the desire for libraries, art galleries, parks, and school buildings, which should occupy in the modern city an architectual position equal to that which the cathedrals occupied in medieval cities, may be as great a stimulator to strenuosity as the desire for moving-picture shows or ice-cream soda. And, certainly, as already suggested, the money spent for these durable goods is just as effectual in giving immediate employment to labor as money spent for ephemeral goods.

Whatever supremacy we give to the merit of laying up treasures in heaven as compared with laying them up on earth, there can be no doubt that if we are going to lay up for ourselves treasures on earth at all, it is much better to build for future generations and an expanding civilization than to consume all our energies in the pleasures of the moment. This question we decide when we make our purchases; for, as said before, it is the direction of our purchases which determines the direction in which our energy shall be expended.

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## JOINT SESSION OF SUBSECTION 1 OF SECTION III AND SUBSECTION 1 OF SECTION VII.[1]

RALEIGH HOTEL,
*Wednesday morning, December 29, 1915.*

Honorary Chairman, I. C. WHITE.
Chairman, VAN H. MANNING.

Papers presented:

Methods and Cost of Obtaining Crude Petroleum, by Thomas Cox.

Legal and Economic Factors in the Conservation of Oil and Gas, by Roswell H. Johnson.

Extent, Mode of Occurrence, and Probable Yield of the Petroleum Fields of Argentina, by E. M. Hermitte.

[1] The papers and stenographic report of this session are found in Vol. VIII of the Proceedings of the Second Pan American Scientific Congress.



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## JOINT SESSION OF SUBSECTION 3 OF SECTION III AND SUBSECTIONS 3 AND 4 OF SECTION V.[1]

RALEIGH HOTEL,
*Wednesday morning, December 29, 1915.*

Chairmen, J. B. WHITEHEAD, N. C. GROVER.

Papers presented:

State Regulation of Water Powers, by Halford Erickson.

Electrochemical Industries, by G. A. Roush.

The Industrial Applications of Electricity, by Philip Torchio.

Present Status of Water-Power Development, by H. W. Buck.

Laws Governing Running Water and Waterfalls, by G. Clodomiro Pereira de Silva.

Laws and Regulations Regarding the Use of Water in Pan American Countries, by Rome G. Brown.

[1] The papers and stenographic report of this session are found in Vol. VI of the Proceedings of the Second Pan American Scientific Congress.



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## SESSION OF SUBSECTION 4 OF SECTION III.[1]

RALEIGH HOTEL,
*Wednesday morning, December 29, 1915.*

Chairman, SAMUEL FORTIER.

The meeting was called to order at 9.30 o'clock by the chairman.

Papers presented:

Irrigation in the United States, by Samuel Fortier.

The water requirement of plants as influenced by environment, by Lyman J. Briggs and H. L. Shantz.

Relation between quantity of irrigation water used and quantity of crop produced, by John A. Widtsoe.

Adaptation of methods of applying water to soils, by S. T. Harding.

### IRRIGATION IN THE UNITED STATES.

By SAMUEL FORTIER,

*Chief of Irrigation Investigations, Office of Public Roads and Rural Engineering, United States Department of Agriculture.*

Over a large part of the arable lands of North and South America the rainfall is insufficient for the profitable production of crops. Over other parts the bulk of the rainfall occurs during the wet season, leaving the balance of the year dry, while throughout the humid portions of the continents droughts of varying frequency and intensity are liable to occur. The natural conditions which prevail in northern Chile, western Peru, northern Mexico, and the southwestern part of the United States illustrate the effects of an inadequate rainfall; and those which prevail in Bolivia, Uruguay, the Willamette Valley of Oregon, and the Great Central Plain of California illustrate the effects of wet and dry seasons. A common characteristic of rainfall everywhere, regardless of country or locality, is the uncertainty of its occurrence and the prevalence of dry spells. While it is true that certain countries and parts of countries lying in the Western Hemisphere suffer from an excessive rainfall, the uneveness of its distribution and its utter lack of dependability, constitute the main obstacles to agricultural development. Such obstacles can only be overcome by furnishing and applying an additional supply of water and this constitutes irrigation.

It is customary to define irrigation as the art of applying water to crops, but its scope is much broader. Successful farming requires that when water

[1] There was no stenographic report of this meeting.



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in sufficient quantities and at the right time does not fall from the clouds, it must be obtained from some other source. A necessary part of irrigation is, therefore, the collection and redistribution of a part of the waters of the earth as well as their application to dry soil. In this broader sense irrigation embraces the design and construction of works for the storage and conveyance of water, the measurement and delivery of water to farmers, the management of irrigation enterprises, the proper use of water in scientific farming, and the laws, institutions, and regulations which govern the appropriation and use of water for such purposes.

For years irrigation in the United States was confined to a few of the more strictly arid States of the Rocky Mountain region. It afterwards spread to the Pacific coast, then to the Great Plains area, later to the Gulf States, and finally to the Atlantic seaboard. The scanty rainfall of the West renders irrigation a necessity. This accounts for the fact that in California, for example, upward of 3,150,000 acres are annually watered by artificial means. But the requirements of a staple crop, such as rice, may likewise necessitate irrigation. Thus, in the Gulf States, Texas, Louisiana, and Mississippi, and in Arkansas, which receive a heavy annual rainfall, about 750,000 acres are irrigated. In Florida, which has an average annual rainfall of about 54 inches, over 20,000 acres of citrus orchards and truck crops have been insured against droughts by the installation of small irrigation plants. To-day there is one-third as many irrigation plants in the small humid State of New Jersey as there is in the large arid State of Arizona, the only difference being in the size of the plants and the acreage served by each.

In few countries of the Western Hemisphere is the need of irrigation greater than in the United States. In the western part, comprising two-fifths of the total area, the rainfall is too scanty, too periodical, or both, to meet the requirements of profitable farming, and in much of the balance of the country destructive droughts prevail which greatly reduce the quantity and impair the quality of what the farmer grows. Apart from its aridity and periodic rainfall, that vast region which lies between the Missouri River and the Pacific Ocean is richly endowed with natural resources. A fertile soil with well-nigh continuous daily sunshine, a dry atmosphere tempering alike the winter's cold and summer's heat, great storehouses of minerals, extensive forests, high waterfalls for the development of power, and unsurpassed scenic grandeur constitute some of the riches which nature has bestowed upon this western land. But neither the richness of the soil nor the agreeableness of the climate can contribute much to the welfare of man without the aid of irrigation. It requires the vivifying touch of water to reclaim and beautify the desert and instill new life into the various industries which are dependent upon this kind of farming.

In the remaining three-fifths of this country, which lies between the Missouri River and the Atlantic Ocean, the uncertainty and unreliability of the rainfall are serious handicaps to the production of foodstuffs. Seldom is the moisture condition of the soil just right. It is either too wet or too dry. These extremes are particularly damaging to the small fruit and truck growers of the Atlantic States. In 1910 out of a total population of 92,000,000 in continental United States about one-third inhabited these States. The three meals which these citizens daily require constitute in the aggregate in any one year not only a large amount of staple foods but also a large amount of vegetables and berries. These latter are grown on high-priced land, heavily fertilized and at great expense for labor. When Jupiter Pluvious sends rain at the right time and in the right quantities, the profits are usually large but

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when droughts occur the receipts from sales may not equal the cost of production. By means of small plants supplemental irrigation is becoming a common feature in the truck districts of the Atlantic Coast. The application of a little water when needed not only produces larger yields and better quality but also earlier crops and this in turn insures better markets and better prices.

Judging from the trend of agricultural development in this country during the past few decades, irrigation is destined to assume vast economic importance. About half a century ago water for irrigation was used in a crude way and in limited quantities by the farmers and stockmen of the Rocky Mountain region. Since then there has been a steady and rapid increase in the area irrigated and also a marked improvement in the character of the works built and the methods and institutions employed. The rapidity of this increase can best be shown by the following figures taken from the decennial census reports:

| Year. | Area irrigated in acres. | Cost of works. |
|---|---|---|
| 1889 | 3,631,381 | $29,611,000 |
| 1899 | 7,518,527 | 66,962,275 |
| 1909 | 13,738,435 | 307,866,369 |
| 1915 | 15,500,000 | (1) |

[1] Estimated.

The foodstuffs grown in this country following the custom of the past, are likely to keep pace with the growth of population. At present the rate of increase in population is about 16,000,000 per decade. With the passing of the decades and the ever-increasing demand for the products of the soil, the improved lands of to-day must yield larger returns and the lands which are now unproductive must, if practicable, be gradually reclaimed. In this work of feeding and clothing those who may dwell here in the years to come, the West desires to do its part. That extensive area of 900,000,000 acres which lies west of the 98th meridian of longitude, contains a vast amount of rich arable land which, under favorable climate and with the aid of irrigation can be made to produce a very large quantity of foodstuffs. The extent of productivity of this region is limited only by the water supply.

There is so much more fertile arable land than there is water to irrigate it that for each locality the amount of the available water supply will always represent more or less definitely its agricultural possibilities. In California, for example, out of a total of 100,000,000 acres there is an area of something like 21,000,000 acres of arable land but the water supply under the present duty of water is likely to be exhausted before 10,000,000 acres are irrigated. Montana may serve as another example. Compared with other arid States, it is well watered, yet when all the available supplies from streams, lakes, reservoirs, and other sources are utilized at least 93 per cent of its total land surface will be beyond the reach of irrigation canals.[1]

But the water of the Western States is also used for purposes other than irrigation. As more people congregate in towns and cities, more water is needed for domestic purposes. The miner and manufacturer take their respective shares, while the storage of water for the development of power is rapidly depleting the natural streams and interfering with their flow for other uses.

[1] Irrigation in Montana by the writer, Bulletin 172, Office of Experiment Stations, U. S. Department of Agriculture.

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In short it may be stated that the material prosperity of the Western States is dependent on the available water supply. If this be true, then every effort should be used to conserve the supply by an economical use.

### PROPER CONTROL OF IRRIGATION WATER.

In reviewing the best methods to adopt in order to bring about the most economical use of the waters of the Western States one of the first things to consider is the proper control of this natural asset. The elevated mountain ranges and table lands constitute the natural cold storage plants of the water supply for this part of the country. The Yellowstone National Park, combined with the Teton Range in Wyoming, is a good example of one of these. Here snow to the depth of 15 to 20 feet frequently covers the landscape during the late winter and early spring months. Unless controlled and redistributed through the agency of National and State Governments and local organizations, this vast amount of latent wealth would flow unutilized to the sea. When the warmth of the spring sunshine caused this snow and ice to melt, a part would rush from tributary to tributary until it reached the Gulf of Mexico through the channels of the Missouri and the Mississippi Rivers. Another part would find its way into the Pacific Ocean through the Snake and Columbia Rivers. But the wealth which is latent in the snow and ice of northwestern Wyoming is not now lost in either the Atlantic or Pacific Oceans. Every year sees a larger volume applied to beneficial uses. By the ingenuity of men these escaping waters are collected, diverted, stored, and redistributed over thirsty soil hundreds of miles distant from the Yellowstone Lake or the mighty Tetons.

To the northwest from this great natural storehouse stretches the Gallatin Valley, Mont., with its fields of waving grain. To the northeast lies the Yellowstone Valley of the same State, with its thousands of acres of alfalfa and sugar beets, while away to the east is the newly developed Big Horn Basin of Wyoming and to the west the famous Snake River Valley of Idaho. These four productive valleys would soon revert to desert conditions were it not for the water which a network of ditches conveys and distributes. The waters of the West Gallatin, the Yellowstone, the Big Horn, and the Snake Rivers are as vital to the welfare of the farmers of these valleys as are the shops and factories to the mechanics of the city. At the same time, the task of conserving the snow on the mountain range and of meting out to each water user in turn his proper share according to his needs is one which has puzzled the best minds of all the ages since the days when Nebuchadnezzar grappled with this world-old problem on the banks of the Euphrates. During the current year the Federal Government is spending $313,000,000 in distributing the mail of the United States, but this task is easy in comparison with the distribution of the water supply of the West. In the case of the latter one can not bottle up the waters as they melt on the Continental Divide in southern Colorado, for example, and send one consignment of packages down the Rio Grande through the States of New Mexico and Texas and the Republic of Mexico, and another set down the San Juan River to the Colorado and thence to the Imperial Valley in California. All controversies which may arise over a proper division of the waters of international streams can be settled only by invoking the treaty-making power of nations. In the case of interstate streams the diversity and complexity of irrigation laws as adopted by the western States, the wide diversity of judicial decisions upon questions relating to water rights, and the absence of what has been termed interstate common law [1] render an equitable apportionment of such

[1] Kinney on Irrigation and Water Rights, p. 2220.

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waters extremely difficult to attain. Similar difficulties arise in the administration of State streams. The city, irrigation company, hydroelectric corporation, miner, and manufacturer may each lay claim to a portion of the flow of the same stream. The contentions which State administrative officers strive to adjust in apportioning the waters of State streams are usually duplicated in each irrigation canal. Every irrigator at the lower end of a system is apt to harbor the belief that his associate who diverts water near the head receives the larger share.

In view of the magnitude of the interests involved and the complicated character of the questions to be settled, it is not surprising that a large part of the laws passed by Western States relate to water and its various uses. It is likewise to be expected that a large part of the time of administrative officers and courts of law should be devoted to this same question. While State officers attempt to settle the larger questions involving the public welfare of the State and the equitable apportionment of water to the various irrigation systems, each system must then take up the work within its jurisdiction and distribute equitably among its water users the volume which it receives from the State. In this manner more or less control of both a public and private character is exercised from the time the water issues from the great natural storehouses until it is delivered in relatively small streams to each individual farmer. The kind of public control exercised by each Western State is dealt with by my associate, Mr. Teele, in a paper which is to follow.

### ECONOMICAL USE OF WATER.

The interpretation of the expression "proper use of water in irrigation" has undergone a marked change since the gold-digging days of California and the Rocky Mountain region. Water was at first free for the taking, and men diverted the flow of streams for beneficial purposes in much the same way that they hunted game, fished for trout, or washed the hillsides for gold.[1] Having built a flume or ditch, the water which it carried they considered belonged to them as much as the elk which they shot or the nuggets which they gathered from their cradles.

So for nearly 25 years after water was first used in the West the capacity of the ditch or flume was the main determining factor in the establishment of a right to the use of water. In the course of time, however, a more general use of water threatened to deplete some of the sources of supply, and in consequence controversies followed by litigation arose. These in turn induced the State legislatures to take a hand in regulating the use of this much-sought commodity. It was then that the beneficial use of water was insisted upon in order to check the lavish prodigality of the appropriators of streams. But beneficial use as interpreted by State administrative officers and judges has in turn failed to satisfy modern requirements. Under the more liberal interpretations of this term any use which benefited the user, no matter how wasteful the method employed, or how much the interests of the public suffered, was frequently upheld by the courts. It was not until after a large number of field experiments had been conducted by State and Federal investigators on the subject of the proper duty of water and the results had been broadly disseminated that men began to realize the vagueness of the term "beneficial use." In consequence those who desired to safeguard the water supplies of the West from overappropriations have adopted the term "economical use," which insures a certain measure of protection to the State as well as to the individual appropriator of water.

[1] Irrigation Institutions, by Elwood Mead.

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There are other social idealists who advocate the "highest and greatest possible duty from the waters of the State in the interests of agriculture and other useful purposes."[1] In accordance with the view of this minority the available water supply of the West should not be used on, say, 50,000,000 acres when there is an additional area of 300,000,000 acres of arable land which require irrigation. They claim that if 3 acre-feet of water produce a larger net return when applied to 3 acres instead of to 1 or 2 acres, a duty of 1 acre-foot per acre should be adopted. Although the time may not have come for the adoption of such ideals in water distribution and use, it is well to set up such standards as will enable the young Commonwealths of the arid region to attain eventually the highest possible development of their land and water resources. With this object in view, attention is briefly called to the present waste of irrigation water and the remedies therefor.

Transmission losses constitute the greatest waste of irrigation water at the present time. These occur in the form of leakage from faulty structures, evaporation from the surface of water and moist earth, and seepage into the earthen channels which convey the water. The census of 1910 showed for that year 81,837 main and lateral ditches, aggregating 125,591 miles in length and having a maximum capacity of 618,097 second-feet. In the United States irrigation canals are for the most part excavated in earth, and, except in a few cases, a large percentge of the water, estimated at 40 per cent of the amount taken in at the heads of the main canals, is lost by absorption and percolation along the routes.[2]

Although many different measures have been tried to render earthen channels impervious, the most effective and, in the long run, the most economical is a lining of concrete, which usually varies in cost from 5 to 15 cents per square foot of lining.

Deep percolation losses on irrigated areas constitute another waste of water. Ordinary soils can not retain much water in each foot of depth, and when an excess is applied to the surface waste occurs through deep percolation. Such losses can be largely prevented by ascertaining the distribution of the water in the soil and subsoil after each application and, if waste is found, lessening the amount applied to the water-holding capacity of the root zone of the plants.

Again, the climatic conditions which prevail in the arid region produce a high rate of evaporation, and unless measures are taken to check such losses a large part of the water applied in irrigation would soon be transferred to the atmosphere. Where feasible, thorough cultivation, a dust mulch, and wetting the soil at night instead of the day have proved effective remedies. Then there is the waste of water arising from poorly prepared fields, uneven surfaces, faulty methods of application, and unskillful handling, each of which exerts an influence in lowering the general efficiency of irrigation water.

The primary cause of some of the losses of water just enumerated is due to certain provisions of water-right contracts and faulty methods of delivering water to irrigators.[3] In the most common form of water-right contract the owners of a canal system agree to deliver a fixed quantity of water for a definite area of land. Under such a provision the farmers have no incentive to economize in the use of water, since their payments are based on a flat rate per acre. Another common mistake is in providing for continuous delivery of irrigation water. It is well known that the needs of crops vary greatly from

[1] "The use of water as affecting the extent of right under the doctrine of prior appropriations," discussed by Frank Adams in California Law Review, Vol. II, No. 5.

[2] Concrete lining as applied to irrigation canals, by the writer, Bul. 126, United States Dept. of Agriculture.

[3] Use of Water in Irrigation, by the writer, McGraw-Hill Book Co.

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seed time to harvest, and the continuous delivery of a fixed volume of water from early spring to late fall is not only wrong in principle but wasteful of water.

It is now quite generally believed that the flat rate per acre and continuous delivery should both be abandoned and that irrigation water should be measured out to each user as his needs require, and that he should pay only for what he gets.

### THE PRESENT STAGE OF IRRIGATION DEVELOPMENT.

The importance of conservation when applied to irrigation, and more particularly to the water which is used in irrigation, is quite generally recognized. While this is true, other phases of the subject demand consideration. Of these perhaps none is so vital as that which deals with the development of irrigation in the future and the policies which shall control both the labor and capital involved. That we may have a clearer view of what lies ahead, permit me to trace the past. This past is memorable for obstacles overcome and achievements won, but it is also marred by wrecked enterprises and blasted hopes.

The history[1] of irrigation development in the arid States may be divided into three more or less distinct periods. The reclamation of bottom lands bordering on streams by individuals, groups of individuals, and corporations constitutes the first of these. In this early development those who owned the land controlled the water and built the necessary works. Almost without exception the lands thus reclaimed proved a financial success. The large profits which accrued from a union of cheap land and cheap water were responsible in a measure for the failures which characterize the period which followed.

The first part of the second period, which may be said to extend from the early eighties to the beginning of the new century, was noteworthy for the extent of its corporate canal building. Both American and foreign capital was readily obtainable, and the prospects of large profits led to the organization of a large number of irrigation companies. These appropriated water and built canals in the optimistic belief of attaining independence in a few years by the sale of water rights and the collection of water rentals. They realized after it was too late that the bulk of the lands under the new system was held by speculators, who would neither use nor pay for the water; that the bona fide settlers were few in number and possessed of little means; that the maintenance and operation of irrigation systems was costly; and that it was the work of a generation instead of a few years to establish prosperous communities under canal systems. The construction work of this period was brought to a rather sudden end by the financial crash of 1893. The balance of this period was occupied in making readjustments. Many promising undertakings had to be abandoned for lack of funds and receivers were appointed for the large majority of the balance. In time, however, conditions approached the normal, the demand for irrigated products increased, prices were better, and many a canal enterprise passed from the control of American and foreign capitalists into the hands of the water users themselves. The West was slowly advancing on this rising tide at the time of the passage of the Carey and reclamation acts. It is true the Carey Act was first passed by Congress in 1894, but owing to defects and omissions in the law little development was effected by it until 1901. The reclamation act was passed in 1902, and the operation of these two measures of constructive legislation, coupled with the

[1] Irrigation Under the Carey Act, by A. P. Stover in An. Rept. Office of Exp. Stations, 1910.

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...ere are many small districts in which the ... ...ation of the waters of the entire ... ...ould probably ... In accordance with the ... ...ation water rights if the land should be ... ...which there is an irrigable area of 30,000,000 acres of ... ...lands available. They would call for ... ...per second from ... ...for per acre should be adopted. ... ...the adoption of such rules as would ... ...such standards as will enable the ... ...which practically the highest possible ... ...be given. With this object in view, attention is ... ...waste of irrigation water and the remedies thereof.

Transmission losses constitute the greatest waste ... ...present time. These occur in the form of leakage ... ...from the surface of water and in earth ... ...channels which convey the water. The canals of ... ...slope, main and lateral ditches, aggregating 16,000 ... ...a maximum capacity of 21,000 second-feet. ... ...canals are for the most part excavated in ... ...large percentage of the water, estimated at 40 ... ...at the heads of the main canals, is lost by ... ...the ranges.[2]

Although many different measures have ... ...nels impervious, the most effective and ... ...is a lining of concrete, which usually ... ...square foot of lining.

Deep percolation losses on irrigated ... ...Ordinary soils can not retain much ... ...an excess is applied to the surface ... ...Such losses can be largely prevented ... ...water in the soil and subsoil after ... ...lessening the amount applied to the ... ...the plants.

Again, the climatic conditions ... ...rate of evaporation, and unless ... ...part of the water applied in irri... ...phere. Where feasible, thorough ... ...soil at night instead of the day ... ...the waste of water arising from ... ...methods of applic... ...ence in lower ...

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[1] P. A. Ewing, formerly connected with the irrigation census.
[2] Irrigation districts in the United States, by Frank Adams.

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achievements of other agencies, constitute the third period of irrigation development.

Before taking up the work of Federal and State Governments in reclaiming desert lands it may be well to add a word concerning the achievements along the same line of private enterprises up to this time. In dealing with the results of private agencies engaged in irrigation development, no general annual records are available, and, apart from estimates, dependence must be placed on the material of each decennial census. According to the census of 1899 there was irrigated in the United States 7,518,527 acres. Thus at the time of the passage of the reclamation act in June, 1902, there must have been in the neighborhood of 8,750,000 acres irrigated at a cost of about $75,000,000 for the construction of works. So great a task, involving so large an outlay, could not have been accomplished by the settlers alone. They were greatly aided, however, by the somewhat lavish expenditures of corporations in building systems, particularly during the canal building decade of 1883 to 1893. Much of this capital was lost as regards the investors, but the works on which it was expended remained and were utilized by the land owners and water users. Such undertakings may therefore be said to be financial failures but agricultural successes.

The provisions of the Carey and reclamation acts are familiar to those interested in irrigation in this country and need not be referred to here at any length. For the benefit of foreign readers the following outlines are given:

Under the Carey Act, reclamation of arid lands is brought about under a kind of cooperation, in which the Nation, the State, corporations, and land settlers all participate. The Federal Government makes a gift of the lands to the States on condition of their reclamation. The States enter into contracts with corporations, and these corporations construct the works and charge the individual settler his pro rata share of the cost, the investment being secured by liens upon lands reclaimed.

The reclamation act of 1902 provides for the setting aside of the greater part of the money derived from the sale of public lands in the Western States into a reclamation fund. This fund is then used under the general supervision of the Secretary of the Interior in making the necessary preliminary surveys and examinations and in constructing the works required for the irrigation of certain tracts of land and apportioning the cost of such works pro rata over the lands to be reclaimed.

It would be a mistake to conclude that irrigation development in this third period was confined to the operations of the Carey and the reclamation acts. All other agencies participated in an effective way. The activity displayed by these two seemed to act as an incentive to others, so that large areas in the aggregate were reclaimed by individual and partnership enterprises, cooperative and mutual canal companies, and corporations organized as common carriers of water. The same may be said of that quasi municipal form of irrigation organization known as the irrigation district.

The extent of land which was reclaimed and actually irrigated by each agency at the close of 1909 is given in the following table:[1]

| | Acres. |
|---|---|
| Individual and partnership enterprises | 6,257,387 |
| Cooperative enterprises | 4,643,539 |
| Commercial enterprises | 1,451,806 |
| Irrigation districts | 538,642 |
| United States Reclamation Service | 395,646 |
| Carey Act enterprises | 288,553 |
| United States Indian Service | 172,912 |

[1] Irrigation in the United States, by R. P. Teele, Thirteenth Census.

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The cost of works to July 1, 1910, according to the same authority, was $307,866,369, and the estimated cost of preparing land irrigated in 1909 was $194,960,000. Complete returns of the value of irrigated crops were not secured at the time of taking the census, but a close estimate of these omissions places the total value at $277,000,000.[1]

### AGENCIES COMPARED.

The student of irrigation can well afford to study with care the irrigation development in this country during the past 13 years. Works have been built and lands reclaimed and settled by a number of agencies acting for the most part independently of each other. It is therefore both interesting and instructive to compare their relative efficiencies on the basis of certain definite standards.

Nothing but praise is due the individuals, groups of individuals and cooperative companies who, with little or no aid from either the Federal of State Governments, have established homes on the desert and thereby made known to the world the agricultural wealth of that vast region beyond the Missouri River. These western pioneers had little money to start with, but they were richly endowed with those physical and mental qualities which brave dangers and overcome difficulties. At the time the last census was taken (1909) this class had reclaimed more than 75 per cent of the total irrigated area. In the development which has taken place during the past decade or more, this class has also taken an active part. Being barred financially from undertaking the larger enterprises they have successfully constructed the smaller systems, improved existing systems, built storage reservoirs, and developed underground water by means of wells and pumping plants. Five years ago the pumping plants which were used for irrigation purposes numbered nearly 16,000, their aggregate cost was over $13,000,000, and they were capable of supplying water to nearly 600,000 acres. This phase of irrigation development has grown to much larger proportions since the census was taken, but no reliable records are to be had.

Commercial enterprises which supply water at stipulated rates to water users who own no interest in the works are not holding their own. The antagonism which so often arises between the officers of the companies and the water users, the high cost of maintenance and operation when compared with the revenue, the passage of State laws adverse to such organizations, and the granting to some public agency the power to regulate the rates charged for water, have tended to check development under this agency.

In comparison with commercial enterprises, the record of irrigation districts has been much more favorable. The success of this particular kind of irrigation institution depends on proper laws, rigid supervision, and efficient management. It also depends on the ability of the districts to finance the undertaking. As will be learned from a paper which is to follow,[2] this agency has seldom had all of these essentials. Notwithstanding defects in State laws governing districts, lack of supervision on the part of States, the poor management exercised on the part of district boards and the difficulty of securing credit to build the necessary works, this form of organization has forged ahead in spite of all obstacles. The extent of land reclaimed and actually irrigated in 1909 under irrigation districts was over half a million acres, but this figure conveys little idea of the amount of thought which has been devoted to this

[1] P. A. Ewing, formerly connected with the irrigation census.
[2] Irrigation districts in the United States, by Frank Adams.

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subject by the people of the West, the many improvements which have been made in all its essential features, the high standing which it enjoys in comparison with some other forms of irrigation organization, and the achievements effected under it during the past five years.

With respect to the operations of the Carey and reclamation acts, the beneficial results thus far secured are not commensurate with the money expended. If the main object of irrigation is to convert desert lands into productive fields and orchards through the establishment of homes and a rural population, then both agencies, when judged by this standard, have proved partial failures. On June 30, 1914, the acreage listed as irrigated under Reclamation Service projects was 761,271 acres. This figure does not represent the extent of land actually reclaimed. In carrying out the provisions of this law it was found advisable to take over from time to time parts or all of existing systems, and these transfers embraced in the aggregate approximately 370,000 acres, leaving a net reclaimed area of 391,271 acres.

More uncertainty exists as to what has been accomplished under the Carey Act in about the same time. We learn from the census that in the season of 1909, 288,553 acres were irrigated, and that the cost of the works up to that time was $33,269,875. In a report[1] submitted to Congress February 21, 1913, on Carey Act projects, the following statement is made:

> It seems likely from fragmentary data that the Carey Act projects as a whole have made water available for an area of 1,200,000 acres, of which possibly 600,000 acres were irrigated (in 1912).

While the purposes to be served are well nigh identical in both acts, there is a marked difference in the essential features of each and in the methods employed in reaching a common end. In the work of reclamation under the Carey Act neither the Nation nor the State assumes any financial responsibility. The Nation makes a gift of the land to be reclaimed and, apart from exercising some slight supervision at the start, does nothing more. The States on their part charge a nominal price of 50 cents per acre for the land included in the projects, exercise a minimum supervision and control, and pass the gigantic task of construction and settlement over to the promoter, the corporation, and the investing public. As a result of this haphazard method of doing business, the investing public has suffered heavy losses in worthless and depreciated irrigation bonds and severe privation and disappointment have been the lot of many settlers.

Under the reclamation act the Federal Government acts as the construction and financial agent of the settlers on the lands reclaimed. It provides the money and builds the works and the settlers pay for the cost in annual installments. On account of a number of defects in the law as first passed, the settlement of the land has not kept pace with the construction of works. The total cost of the works as well as the yearly expenditures for operation and maintenance was to be repaid in 10 years. The large majority of those who took up land under the reclamation projects could not comply with this provision. Again, since the settlers were bound by hard and fast regulations to pay for all expenditures, they might have been given some voice in deciding such questions as the size of the irrigation farm, the amount of water required, the time of delivery, and the maintenance and operation of the distributaries. Finally, an abundance of money and an eager desire on the part of engineers to build works led the management to expend millions of dollars in construction with little apparent thought of the settlers' welfare or of the final outcome.

[1] Senate Doc. 1097, Carey Act Projects, by Herman Stabler, P. R. Dudley, and F. W. Hanna.

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### OVERCONSTRUCTION.

This brings up another important phase of the present situation. The activities of a number of agencies in building irrigation works have resulted in overconstruction. In addressing the National Irrigation Congress at Sacramento, Cal., in 1907, on the subject "The greatest need of arid America," the writer called attention to the fact that the rapid construction of irrigation works was likely to progress far in advance of the actual settlements of the lands to be reclaimed, and that unless settlement followed closely after construction large sums of money would be lost in the maintenance and operation of the works. Attention was called also to the further fact that a million people were then needed to utilize the land and water which had been provided. The truth of the latter statement was corroborated by the irrigation census of 1910. In that year the extent of irrigable land included in projects but not irrigated under the various agencies was as follows:

| | Acres. |
|---|---|
| Cooperative enterprises | 4,186,658 |
| Commercial enterprises | 3,668,171 |
| Carey Act enterprises | 2,265,321 |
| United States Reclamation Service | 1,677,370 |
| Irrigation districts | 1,052,823 |
| Total | 12,850,343 |

The foregoing figures include the unirrigated portions of farms and a large area in the aggregate which for one reason or another may never be irrigated. Even when all such areas are deducted there remain in all probability 9,000,000 acres for which water has been provided but which are unreclaimed for lack of settlers. During the five years which have elapsed since the census was taken the situation as regards overconstruction and the need of more settlers has grown worse instead of better. The greatest need of the arid portion of the United States to-day is therefore not more works but more farmers to utilize the land and water which have been provided.

### THE SETTLEMENT OF IRRIGABLE LANDS.

The people of this Nation are still land hungry. The century-old migration from east to west to take up land and establish homes has not ceased. The severity of conditions has only checked it. If the Nation had another Iowa to offer to the homesteader, with what haste would men rush to the new territory. It is because of the forbidding aspect of the desert and the many obstacles that have to be met and overcome that men hesitate to undertake such a task. The settlement of irrigable lands is not an undertaking for weaklings or incompetents. It requires brawn and brain as well as grit to make a successful fight against aridity. The costly works built in recent years to provide water has called for another qualification on the part of the settler. He must have money. An expenditure of $1,500 to $2,500 is required in order to obtain an advantageous start. It is therefore evident that one of the first essentials of the successful settlement of irrigable lands is to select the settlers. This is a matter of vital interest to every Western State. If the wrong class of people is induced to take up land under irrigation projects failures will result and both the project and the State will be discredited. On the other hand, only good can come to all concerned by securing the right class of settlers in the first place. A wise selection of home builders is certain to exert so lasting an influence that the State should use every endeavor to draw to itself desirable citizens. The Western States, in cooperation with the Nation, should carefully se-

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lect the intending immigrant before he leaves his native land and birthplace, in order to exclude those unfitted to overcome the obstacles and endure the hardships of pioneer conditions in an arid region. The same practice might well be followed in the case of native or foreign-born Americans.

While successful colonization depends primarily on selecting the right kind of farmers, the process of selection in itself will avail but little, no matter how carefully planned and executed, unless the new settlers can be assured of a reasonable measure of success as a reward for their industry. Under the conditions which have prevailed for the past few years this class has been more or less handicapped, and in the interests of all concerned such handicaps should be removed if possible. Costly irrigation works without water users resemble a railroad without traffic or a hotel without guests. The one is a necessary complement of the other.

In briefly referring to some of the burdens which have been imposed on those who settled under irrigation systems, mention should be made of the inflated value of raw land. The decision to construct a system or project invariably led land dealers to take advantage of the opportunity to buy worthless desert lands at a low price and resell them as irrigable lands at a very large profit. Instead of permitting the settler to receive the benefit of the unearned increment in land values arising from the organization of a project and the construction of the system, this "easy money" went into the pockets of the land dealers.

Again, the high price of water constitutes another handicap to the settler under the newer systems. On many of the older systems the cost of a water right did not exceed $10 per acre. This cheap water was applied to land which probably cost less than $5 an acre. With so favorable conditions at the start, success was fairly well assured. To-day few water rights can be bought for less than $25 an acre, and some run up to $100 an acre. When a high price for a water supply is coupled with an inflated value for the raw land the making of the first payment on both, not to mention the subsequent payments and interest, deprives many a purchaser of much-needed capital.

A large amount of labor and money also must be expended at the start in clearing the land of desert growths, plowing, leveling, and grading it, building the necessary supply and farm ditches, and in general preparing the land for successful irrigation and profitable crops. This cost throughout the arid region varies all the way from $9 an acre in Wyoming to $20 in California. In 1909 the total estimated cost of preparing the land then irrigated was, in round numbers, $195,000,000, and the estimated final cost when all the projects then underway will be completed was $443,000,000. In other words, apart from the cost of the works, which is a lien on the land reclaimed, the cost of preparing the land under the new works which were begun but not settled in 1909 will call for an expenditure on the part of the settlers of $248,000,000.

In view of these and other difficulties with which the new settler has to contend it is evident that more attention must be given to the farmers' part in reclamation work if the projects now underway are to be successful. This feature will be briefly discussed under the next topic.

### PLANS FOR FUTURE DEVELOPMENT.

The first part of the twentieth century will long be remembered as a notable period in the construction of irrigation works. So much activity in one kind of development, however, has detracted attention from another no less important. As previously stated, the farmers' part in irrigation development has been given scant consideration, and when too late it is realized that no suc-

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cess is possible without his cooperation. It is therefore evident that in formulating plans for the future an effort should be made to strengthen this and other weak features. The experience of the past decade has demonstrated the fact that the ordinary settler can not prepare his farm for successful irrigation and profitable crops and at the same time pay for both land and water in 10 yearly installments. It has also been amply demonstrated by past experience that private capital can not afford to build irrigation works and incur the risk of being repaid by those who may elect to settle on the lands thus made irrigable. Up to the present about 95 per cent of the area reclaimed by irrigation has been effected through the agencies of private capital and irrigation farmers. With the loss of millions of dollars in irrigation securities still keenly felt by investors, little financial assistance can be expected from this class for years to come. At the same time the task is altogether too great for farmers to accomplish without financial backing. It would therefore seem as if the present situation presented two alternatives—one, a continuation of the present stagnation, and the other governmental participation in irrigation development. Fortunately this topic has been selected for consideration by all Pan American countries at this congress, and it is therefore fitting that we should at this time seek to determine wherein it is applicable to the needs of the United States. It will be noted that the words "governmental participation" are to be interpreted in their broadest sense, the word "government" including the Nation, State, county, province, or other political subdivision, and the word "participation," the construction, management, and settlement of irrigation enterprises.

With reference to the United States, if dependence is alone placed on the Federal Government for aid, there is reason to believe that the benefits will be too long delayed and not altogether satisfactory when they are received. Neither will it be satisfactory to depend alone on the State. Hitherto each Western State has been content to stand aloof and profit by the expenditures of private capital and the Federal Government in converting deserts into fields and orchards and thus greatly increasing the revenue of the State. As previously stated, the individual has not been financially able to undertake so costly enterprises, and the community is too frequently handicapped by a lack of organization, and when organized by the difficulty of securing the necessary credit to construct works. If the laws which have been enacted and put into operation for the reclamation of arid lands have failed to accomplish what was expected of them, it is in a measure due to the fact that no broad irrigation policy has ever been formulated. All efforts at legislation thus far made have failed to correlate the various working forces and unite them into one systematic body. It is believed that cooperation will remedy this defect and that it will be the foundation of the irrigation policy of the future. The Nation, the State, the community, the corporation, and the water user ought to cooperate in such a way that each will perform the task best suited to its or his conditions. So many agencies, differing so essentially in organization, aims, and methods, can not perform the same task with equal proficiency. But this fact has been ignored by our statesmen. Much of both National and State legislation seems to have had for its object the organization of independent units. The irrigation district, the mutual water company, and the commercial irrigation enterprise are the creations of the State; the Government reclamation project is the creation of the National Government. The purpose for which all of these were created does not differ; the task assigned to each is practically the same, yet all work independently of each other and all are more or less competitors. Thus there exists a situation the very reverse of

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cooperation. The National Government is employing all the cumbersome machinery of the Nation to dig and operate distributary ditches which should be the work of farmers. On the other hand, weak communities and companies are undertaking the construction of large storage reservoirs and other structues, which should be designed, built, and controlled by the National Government. If we are to profit by the failures of the past, it would seem highly desirable to consider the reclamation of arid lands as a national problem in which the Nation, the State, and the individual have common interests, and further, to assign to each agency engaged in reclamation work the part which it is best fitted to perform.

To accomplish this end the reclamation act should be amended in such a way as to provide that the money derived from the sales of public lands be henceforth used in the construction of large storage reservoirs and other works designed to increase the available water supply and that the water so stored be sold at cost to communities, irrigation districts, mutual water companies, and individuals under proper restrictions and regulations. The reclamation of public lands might be continued under an amended form of the Carey Act. Under this act as amended the Federal Government would construct by means of reclamation funds the main structures and the State, acting through various agencies, would build and operate the distributaries and assist the entrymen in the preparation of their farms, the erection of the necessary buildings, and, in short, to see to it that each entryman was equipped in such a way that he could at least make a living for himself and family.

Then, too, in the irrigation development of the future each Western State would be compelled, we believe, to take an active and a leading part. Irrigation farming is too vital to be neglected. The wealth which is stored up in the fertile soils of the arid regions is its greatest asset, and as long as water is available the authority vested in the State should be exercised in a judicious manner in the gradual and systematic development of its land and water resources.

In extent of area the Kingdom of Spain is but a trifle larger than California, with a somewhat smaller irrigated area. As regards irrigation, Spain may be compared, therefore, with one of our Western States, and in doing so it may be of interest to note the policy of this Kingdom toward irrigation. The State has recently expended over $7,000,000 in constructing the canal of Aragon and Catalonia for the purpose of irrigating some 260,000 acres in the northeastern part of the country. The cost of this system when complete will probably exceed $10,000,000, but this expenditure on the part of the State is justified on the ground of increased revenue from the land. Before being irrigated the dry land is taxed 57 cents per acre and the irrigated land $1.75 per acre.[1] This difference, when applied to all the lands under the system, amounts to over $300,000 a year, which represents 3 per cent of the capital invested by the State in this one enterprise. The increase in taxes is only one of the many benefits which the State receives. The increase in crops, population, manufacturing plants, transportation, and commerce vitalize a large number of industries, and the total revenue derived by the State is estimated at 9 per cent of the capital invested.

Italy, which is no larger than the State of Nevada and has 3,500,000 acres under irrigation, has gone even further than Spain in aiding irrigation development. The State not only builds, maintains, and operates canal systems, charging low rates to water users, but it also grants annual subsidies on the capital invested in irrigation works. A new law is now being considered by the Italian Parliament which proposes to increase these grants up to 60 years

[1] Canal de Aragon y Cataluna, by Rafael de la Escasura.

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and to lend money at 2 per cent per annum, repayable in 50 years, to any farmer who needs it for adapting his land to irrigation.[1]

Irrigation development in the United States seems to have reached a stage where substantial aid must be given by the States most vitally interested if progress is to continue. In comparatively few localities is there any need at present for providing a water supply, since large areas, in the aggregate, under existing systems are not being utilized for lack of farmers. There is, however, an imperative need for each Western State to colonize its irrigable lands and to extend aid to both old and new settlers. The State, if it chooses, can go far in controlling through its various organizations the prices to settlers of irrigable lands and water rights. It can likewise provide for a system of rural credits whereby the family that is attempting to establish a home under a canal system, as well as all who are engaged in farming, can secure small loans on the best possible terms. Lastly, the State can give additional financial aid to all State institutions, such as the agricultural college and the experiment station, which have for their purpose the improvement of rural communities. Such agencies, working in cooperation with the various branches of the Federal Government, can do much to curtail the losses and increase the prosperity and happiness of the irrigation farmer.

## THE WATER REQUIREMENT OF PLANTS AS INFLUENCED BY ENVIRONMENT.

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The term "water requirement" is used to indicate the ratio of the weight of water absorbed by a plant during its total period of growth to the weight of dry matter (exclusive of roots) produced during this same period. The water requirement of a grain-producing crop can be expressed either in terms of total dry matter or on the basis of grain production alone by dividing the total weight of water absorbed during the whole period of growth by the total dry matter or by the weight of the grain, respectively.

The water requirement of crops is a matter of special importance in the western United States in sections where the low rainfall is the principal factor limiting plant growth. It is also of importance in irrigated sections, since the water consumed by the crop determines to a large extent the amount of water which must be added through irrigation.

### METHODS.

The method used by the writers[2] in measuring the water requirement differs in some respects from the methods heretofore employed. The crops under investigation are grown in large pots containing a sufficient amount of soil (115 kilos

[1] Italian Irrigation, by Prof. Luigi Luggi, D. Sc., in paper before the International Engineering Congress, San Francisco, 1915.

[2] For a detailed description of the method, see Briggs, L. J., and Shantz, H. L., "The Water Requirement of Plants—I. Investigations in the Great Plains in 1910 and 1911," Bur. Plant Ind. Bul. 284 (1913). "Relative Water Requirement of Plants," Jour. of Agr. Research, U. S. Dept. Agriculture, Vol. III. No. 1 (1914).

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or more) to enable the plants to make a normal growth and attain mature development. The pots are provided with tight-fitting covers with openings for the plants, the annular space around each stem being sealed with wax. In this way water is prevented from entering the pots during periods of rain and direct evaporation from the soil is avoided. The initial and final weighings of the pots are made with an accuracy of one-tenth of a kilogram, and intermediate weighings are made regularly three times a week in order to determine the amount of water required to maintain the soil at a suitable water content. The water added is measured in calibrated 2-liter flasks. By determining the initial and final weight of the pots and recording the total amount of water added to each pot, the amount of water transpired is easily computed. The crop is harvested when ripe, oven dried, and the total amount of dry matter produced by each pot is determined, from which the water requirement of the plants grown in each pot can be calculated. Six pots of plants of each variety are grown in order to reduce experimental errors and to provide a basis for computing the probable error of the mean.

In order to protect the plants from severe hail and wind storms it has been necessary to conduct the experiments in screened inclosures, which reduce the sun's intensity about 20 per cent and also reduce the water requirement by a similar amount, compared with plants grown under freely exposed conditions. Plants grown in the inclosure also have a water requirement about 10 per cent lower than the same variety grown in pots sunk in trenches surrounded by a field of the same grain.

As a further check on the relative water requirement of crops grown under field conditions and in the screened inclosure, we have made direct determinations of the water requirement of crops grown in field plats. The results of such measurements are given in Table I:

TABLE I.—*Comparison of the water requirement of Kubanka wheat crops grown under field conditions and in pots at Akron, Colo.*

| Class of experiments. | Water requirement. | | | |
|---|---|---|---|---|
| | Including rainfall during growth. | | Excluding rainfall during growth. | |
| | Based on dry matter. | Based on grain. | Based on dry matter. | Based on grain. |
| Field experiment, 1910 | 700 | 2,315 | 486 | 1,780 |
| Field experiment, 1911 | 862 | 2,380 | 466 | 1,614 |
| Pot experiment, 1911 | ..... | ..... | 468±8 | 1,196±15 |

Soil moisture determinations were made at seedtime and at harvest by means of an extensive series of soil samples. The rainfall absorbed by the soil during the period of growth was also computed from daily moisture determinations. The water requirement of Kubanka wheat in 1910 and 1911 determined in the field was found to be 700 and 862, respectively. The water requirement of Kubanka wheat in the pot experiment in 1911 was only 468. Both seasons were deficient in rainfall during the growing period, none of the rains penetrating below the first foot. These rains also occurred at a time when the crop was drawing its moisture supply mostly from stored moisture in the subsoil. Since wheat at this stage of growth is poorly adapted for absorbing moisture from the temporarily moistened surface soil, it is probable that the greater proportion of the rainfall absorbed by the soil during the growing period was lost by direct evaporation into the air and was not utilized by the plants. If the water supply from rains during the growing season is ignored, the water requirement of Kubanka wheat, based on the amount of stored moisture removed, is 486 and 466 for the two years, which agrees well with the pot determinations.

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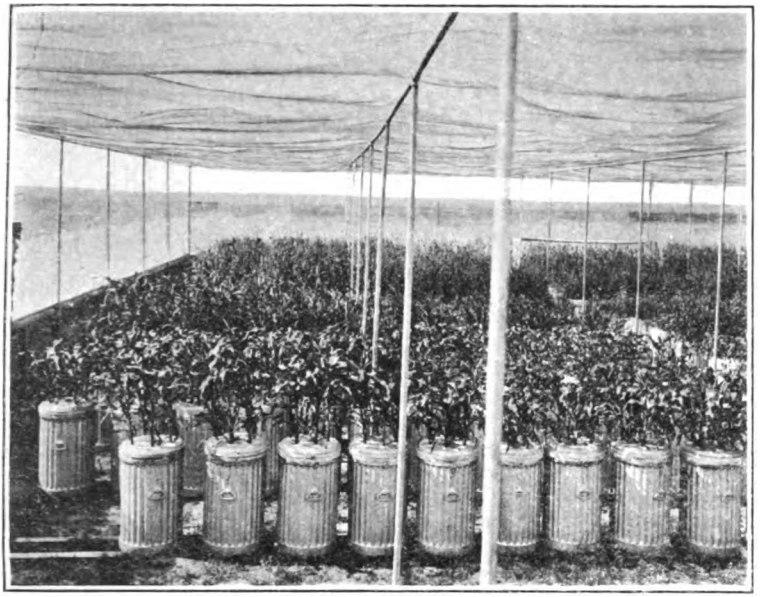

FIG. 1.—GENERAL VIEW INSIDE THE PLANT INCLOSURE USED AT AKRON, COLO., SHOWING PIPE FRAMEWORK COVERED WITH HAIL SCREEN, WITH A BOARD BASE SURMOUNTED BY A SINGLE WIDTH OF CHEESECLOTH.

The shelter is for protection against hail and high winds. Corn and sorghum are shown in the foreground and the small grains in the background.

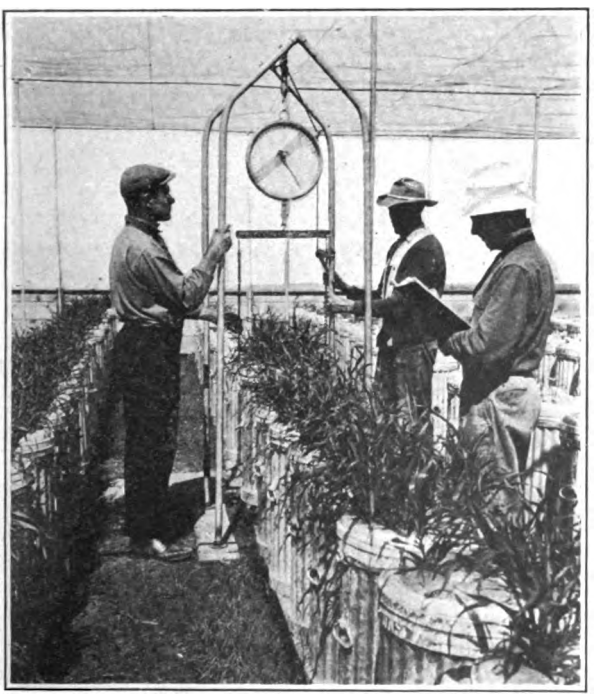

FIG. 2.—WEIGHING THE POTS, SHOWING SPRING BALANCE, WEIGHING SUPPORT, AND GENERAL PROCEDURE.

Two men operate the weighing support, one of whom lifts the pot by means of a windlass, while a third reads the balance and records the weight. By this method weighings can be made at the rate of two per minute.



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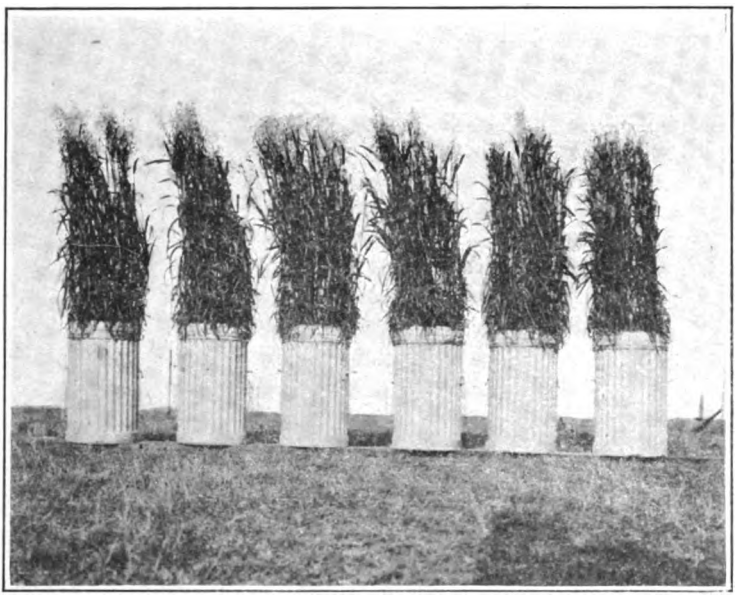

FIG. 3.—SWEDISH SELECT OATS, SHOWING LUXURIANT AND UNIFORM GROWTH.

Six pots of each crop are grown and the water requirement of each pot measured separately. By this means the probable error of the result of the crop can be expressed.

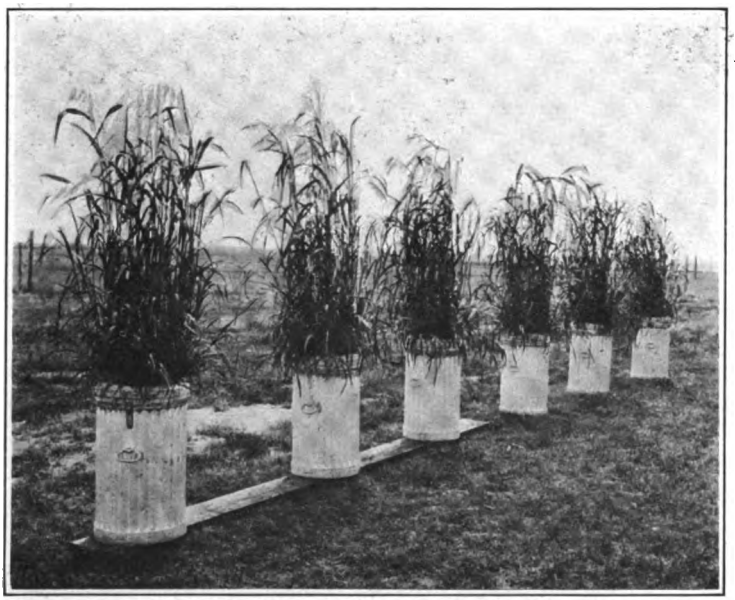

FIG. 4.—SUDAN GRASS, SHOWING A LUXURIANT AND UNIFORM GROWTH IN EACH OF THE SIX POTS.



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### THE RELATIVE WATER REQUIREMENT OF CROPS.

The standard crops differ greatly in respect to their efficiency in the use of water, and varieties of the same crop also show measurable differences. The wide range in the water requirement of different plants is shown in Table II, in which is presented a summary of the water requirement determinations at Akron, Colo., for the three years 1911, 1912, and 1913.

The results given in this table comprise measurements of 44 species and varieties in 1912 and 55 in 1913. The writers' 1911 measurements have also been included. The years 1911 and 1913 were similar in character, and the same plants grown during both years gave practically the same water requirement. The year 1912 was cooler and the evaporation and light intensity were much lower. These conditions had a marked influence on the water requirement, the mean water requirement in 1912 being only 77 per cent of that in 1911 and 1913. In order to place all of the determinations upon a comparative basis the 1912 measurements have accordingly been increased 30 per cent in the table.

TABLE II.—*Summary of water-requirement determinations at Akron, Colo., in 1911, 1912, and 1913, based on the production of dry matter.*

| Plant. | Botanical name. | Number of observations (years). | Water requirement. | |
|---|---|---|---|---|
| | | | Of species or variety. | Mean of genus. |
| **GRAIN CROPS.** | | | | |
| Proso: | | | | |
| Voronesh, C. I. 16 | Panicum miliaceum | 1 | 268±1 | |
| Tambov, S. D. 366 | do | 1 | 270±1 | 293 |
| Black Voronesh, S. D. 334 | do | 1 | 341±10 | |
| Millet: | | | | |
| Kursk, S. P. I. 30029 | Chaetochloa italica | 1 | 261±15 | |
| Kursk, S. P. I. 34771 | do | 2 | 265±3 | |
| Kursk, S. P. I. 22420 | do | 1 | 287±2 | 310 |
| German, S. P. I. 26845 | do | 2 | 293±9 | |
| Turkestan, S. P. I. 20694 | do | 1 | 444±9 | |
| Sorghum: | | | | |
| Kafir, Dwarf Blackhull, C. I. 340 | Holcus sorghum | 1 | 285±3 | |
| Kaoliang, brown, S. P. I. 24993 | do | 2 | 296±2 | |
| Kafir, White, C. I. 370 | do | 1 | 297±4 | |
| Red amber, S. P. I. 17563 | do | 3 | 301±2 | |
| Kafir, Early Blackhull, C. I. 472 | do | 1 | 302±13 | |
| Minnesota Amber, A. D. I. 341-13 | do | 2 | 305±2 | |
| Kafir, Blackhull, S. P. I. 24975 | do | 2 | 308±4 | |
| Milo, white, C. I. 365 | do | 1 | 317±3 | 322 |
| Kafir Durra, C. I. 198-15-3 | do | 1 | 321±5 | |
| Feterita, C. I. 182 | do | 1 | 323±4 | |
| Milo, S. P. I. 24960 | do | 1 | 324±4 | |
| Durra, white, S. P. I. 24997 | do | 1 | 327±2 | |
| Milo, dwarf, S. P. I. 24970 | do | 2 | 344±3 | |
| Sudan grass, S. P. I. 25017 | Holcus sorghum sudanensis. | 1 | 467±9 | |
| Corn: | | | | |
| Esperanza | Zea mays | 2 | 315±3 | |
| China White×Esperanza | do | 1 | 325±2 | |
| Indian Flint | do | 1 | 342±5 | |
| China White×Hopi | do | 1 | 345±3 | |
| Hopi | do | 2 | 361±6 | |
| China White×Laguna | do | 1 | 376±5 | 368 |
| Northwestern Dent | do | 3 | 377±7 | |
| Laguna | do | 1 | 384±8 | |
| Bloody Butcher | do | 1 | 405±7 | |
| Iowa Silvermine | do | 2 | 407±5 | |
| China White | do | 2 | 413±5 | |
| Teosinte: | | | | |
| China White×Teosinte | | 1 | 376±4 | 383 |
| Teosinte | Euchlaena mexicana | 1 | 390±11 | |
| Wheat: | | | | |
| Turkey, C. I. 1571 | Triticum aestivum | 1 | 473±8 | |
| Kharkov, C. I. 1583 | do | 1 | 475±8 | |
| Kubanka, C. I. 1440 | Triticum durum | 3 | 492±4 | |
| Galgalos, C. I. 2398 | Triticum aestivum | 1 | 496±4 | 513 |
| Emmer, C. I. 2951 | Triticum dicoccum | 2 | 545±7 | |
| Spring Ghirka, C. I. 1517 | Triticum aestivum | 2 | 550±3 | |
| Marvel Bluestem, C. I. 3082 | do | 2 | 559±4 | |

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TABLE II.—*Summary of water-requirement determinations at Akron, Colo., in 1911, 1912, and 1913, based on the production of dry matter*—Continued.

| Plant. | Botanical name. | Number of observations (years). | Water requirement. Of species or variety. | Water requirement. Mean of genus. |
|---|---|---|---|---|
| **GRAIN CROPS—continued.** | | | | |
| Barley: | | | | |
| Hannchen, C. I. 531 | Hordeum distichon | 2 | 502±4 | 534 |
| Beardless, C. I. 716 | Hordeum vulgare | 2 | 534±7 | |
| Beldi, C. I. 190 | do | 2 | 542±3 | |
| White Hull-less, C. I. 595 | do | 2 | 556±2 | |
| Buckwheat | Fagopyrum vulgare | 1 | 578±13 | 578 |
| Oats: | | | | |
| Canadian, C. I. 444 | Avena sativa | 2 | 559±8 | 597 |
| Swedish Select, C. I. 134 | do | 3 | 594±4 | |
| Burt, C. I. 293 | do | 3 | 613±3 | |
| Sixty-day, C. I. 165 | do | 2 | 622±9 | |
| Rye, spring, C. I. 73 | Secale cereale | 2 | 685±7 | 685 |
| Rice, Honduras, C. I. 1643 | Oryza sativa | 2 | 710±15 | 710 |
| Flax, North Dakota, No. 155 | Linum usitatissimum | 1 | 905±25 | 905 |
| **OTHER CROPS.** | | | | |
| Beet, sugar: | | | | |
| Morrison-grown Kleinwanzleben | Beta vulgaris | 2 | 397±6 | 397 |
| Potato: | | | | |
| Irish Cobbler | Solanum tuberosum | 2 | 554±9 | 636 |
| McCormick | do | 1 | 717±11 | |
| Crucifers: | | | | |
| Cabbage, Early Jersey Wakefield | Brassica oleracea capitata. | 1 | 539±7 | 640 |
| Turnip, Purple-Top | Brassica rapa | 1 | 639±31 | |
| Rape | Brassica napus | 1 | 743±7 | |
| Cotton, Triumph | Gossypium hirsutum | 2 | 646±11 | 646 |
| Cucurbits: | | | | |
| Watermelon, Rocky Ford | Citrullus vulgaris | 1 | 600±15 | 600 |
| Cantaloupe, Rocky Ford | Cucumis melo | 1 | 621±27 | 667 |
| Cucumber, Boston pickling | Cucumis sativus | 1 | 713±11 | |
| Squash, Hubbard | Cucurbita maxima | 1 | 748±8 | 791 |
| Pumpkin, common field | Cucurbita pepo | 1 | 834±17 | |
| Legumes: | | | | |
| Cowpeas, S. P. I. 29282 | Vigna sinensis | 1 | 571±3 | 571 |
| Chick-pea, S. P. I. 24322 | Cicer arietinum | 1 | 663±18 | 663 |
| Bean, navy | Phaseolus vulgaris | 1 | 682±4 | 728 |
| Bean, Mexican | do | 1 | 773±8 | |
| Bean, soy, S. P. I. 21755 | Soja max | 1 | 672±9 | 744 |
| Bean, soy (wild), S. P. I. 25138 | do | 1 | 815±26 | |
| Clover, sweet, S. P. I. 21216 | Melilotus alba | 2 | 770±5 | 770 |
| Pea, garden, S. P. I. 30134 | Pisum sativum | 1 | 775±5 | 788 |
| Pea, garden, S. P. I. 22637 | do | 1 | 800±17 | |
| Vetch, hairy, S. P. I. 34268 | Vicia villosa | 1 | 690±8 | 794 |
| Bean, horse, S. P. I. 25645 | Vicia faba | 1 | 772±11 | |
| Bean, horse, S. P. I. 15429 | do | 1 | 780±10 | |
| Vetch, purple, S. P. I. 18131 | Vicia atropurpurea | 1 | 935±9 | 797 |
| Clover, red, S. P. I. 34869 | Trifolium pratense | 1 | 789±9 | |
| Clover, crimson, S. P. I. 33742 | Trifolium incarnatum | 1 | 805±8 | |
| Alfalfa, Peruvian, S. P. I. 30203 | Medicago sativa | 1 | 651±12 | 831 |
| Alfalfa, Grimm, A. D. I. E-23-20-52 | do | 2 | 844±8 | |
| Alfalfa, yellow-flowered | Medicago falcata | 1 | 865±18 | |
| Alfalfa, Grimm, S. P. I. 25695 | Medicago sativa | 2 | 963±9 | |
| Grasses: | | | | |
| Wheat-grass | Agropyron desertorum | 1 | 705±27 | 861 |
| Brome-grass | Bromus inermis | 1 | 1,016±26 | |
| **NATIVE PLANTS.** | | | | |
| Tumbleweed | Amaranthus graecizans | 1 | 277±4 | 287 |
| Pigweed | Amaranthus retroflexus | 2 | 297±4 | |
| Purslane | Portulaca oleracea | 1 | 292±11 | 292 |
| Grass, buffalo | Buchloe dactyloides | 1 | 308±17 | 308 |
| Thistle, Russian | Salsola pestifer | 1 | 336±5 | 336 |
| Grass, buffalo and grama | Bulbilis dactyloides / Boutsloua oligostychya | 1 | 389±12 | 389 |
| Cocklebur | Xanthium commune | 1 | 432±13 | 432 |
| Gumweed | Grindelia squarrosa | 1 | 608±23 | 608 |
| Sage, mountain | Artemisia frigida | 1 | 616±18 | 616 |
| Sunflower (Akron) | Helianthus petiolaris | 1 | 774±20 | 683 |
| Sunflower (sand hills) | do | 1 | 570±11 | |
| Sunflower | Helianthus annuus | 1 | 705±8 | |
| Lamb's quarters | Chenopodium album | 1 | 801±41 | 801 |
| Marigold, fetid | Boebera papposa | 1 | 881±26 | 881 |
| Ragweed, western | Ambrosia elatior | 1 | 948±66 | 948 |
| Wheat-grass, western | Agropyron smithii | 1 | 1,076±29 | 1,076 |

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The results given in the summary table therefore represent the water requirement of the plants for years similar to 1911 and 1913, when grown in a screened inclosure, which reduces the solar radiation to 80 per cent of its normal value. According to measurements made with wheat, alfalfa, and cocklebur, the removal of the inclosure would increase the water requirement as given in the table by 25 per cent. The plants grown outside the inclosure were isolated and freely exposed, while plants under field conditions mutually protect and shade one another to some extent. Comparison with wheat plants grown in pots sunk in trenches indicates that the inclosure measurements, at least in the case of wheat, are less than 10 per cent below the water requirement of plants exposed under field conditions.

These measurements represent the relative water requirement of the different plants tested, subject to the limitations imposed by the difference in the growth period of the plants. The measurements in 1912 would also indicate that the character of the season influences the water requirement of some plants more than others. For this reason, where the results of two or more years have been combined in the table the probable error has been confined to the errors of experiment and does not include the fluctuations in water requirement due to the season.

In order to facilitate comparison the plants have been arranged under three main heads—grain crops, other crops, and native plants. Under "Grain crops" are also included certain sorghums and millets, which are usually grown for forage. Under the heading "Other crops" are included principally the legumes, cucurbits, crucifers, sugar beets, cotton, and potatoes, as well as some of the introduced grasses. Under the heading "Native plants" are listed indigenous species, as well as certain introduced species which have become thoroughly established.

The grain crops fall rather naturally into two sections—those of low water requirement (proso, millet, sorghum, and corn) and those of high water requirement (wheat, barley, oats, rye, and flax). The plants with a comparatively low water requirement are late-manuring crops, which make their best growth during the hottest and driest portion of the summer. The plants having a comparatively high water requirement mature during midsummer and make their best growth during the earlier, cooler period of the year. The range in water requirement of the first group is from 261 for Kursk millet to 467 for Sudan grass, while the range in the second group is from 473 for Turkey wheat to 905 for flax.

Representing the water requirement of proso as 1, the water requirement of the grain crops is as follows: Millet, 1.06; sorghum, 1.10; corn, 1.26; teosinte, 1.34; wheat, 1.76; barley, 1.83; buckwheat, 1.98; oats, 2.04; rye, 2.34; rice, 2.42; and flax, 3.38. In other words, flax requires more than three times as much water and rice more than twice as much water as proso and millet in producing a pound of dry matter.

In the second group sugar beet ranks first, having a water requirement almost as low as corn. Potato ranks next, followed by crucifers, cucurbits, legumes, and grasses, in order. A wide range is shown in each of these families. The groups as a whole show a range somewhat less than the grain groups.

Representing the water requirement of sugar beet as 1, the values for the "Other crops," exclusive of the legumes, are as follows: Cabbage, 1.36; Irish Cobbler potato, 1.39; watermelon, 1.51; cantaloupe, 1.57; turnip, 1.60; cotton, 1.63; cucumber, 1.80; wheat grass, 1.85; rape, 1.87; squash, 1.89; pumpkin, 2.10; and brome grass, 2.56.

The cowpea was the most efficient of the legumes. Representing its water requirement by 1, that of the other legumes is as follows: Peruvian alfalfa, 1.14; chick pea, 1.16; soy bean, 1.18; navy bean, 1.20; hairy vetch, 1.21; sweet

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clover, 1.35; Mexican bean, 1.35; horse bean, 1.36; red clover, 1.38; garden pea, 1.38; crimson clover, 1.41; wild soy bean, 1.42; select Grimm alfalfa, 1.48; yellow-flowered alfalfa, 1.51; purple vetch, 1.64; and unselected Grimm alfalfa, 1.69.

The native plants show a range in water requirement greater even than the cultivated crops. Amaranths, buffalo and grama grasses, purslane, and Russian thistle have a low water requirement and compare favorably with millet and sorghum, while sunflower, fetid marigold, western ragweed, and western wheat grass have a high water requirement, about equal to that of alfalfa.

Representing the water requirement of tumbleweed (Amaranthus graecizans) as unity, the water requirement of these native plants is as follows: Purslane 1.05; pigweed, 1.07; buffalo grass, 1.11; Russian thistle, 1.21; buffalo and grama grasses, 1.40; cocklebur, 1.56; gumweed, 2.20; mountain sage, 2.22; sunflower, 2.56; narrow-leaved sunflower, 2.80; lamb's quarters, 2.89; fetid marigold, 3.18; western ragweed, 3.42; western wheat grass, 3.89.

Varieties of the same crop often differ widely in water requirement. In the case of barley, the variety having the highest water requirement was 8 per cent above the lowest; oats, 11 per cent; wheat, 18 per cent; proso, 27 per cent; corn, 31 per cent; vetch, 35 per cent; alfalfa, 48 per cent; sorghum, 60 per cent; and millet, 70 per cent. This wide range in water requirement among the varieties of many crops encourages the belief that strains may yet be secured which are still more efficient in the use of water than those now grown in dry-land regions.

### FACTORS AFFECTING THE WATER REQUIREMENT.

The measurements presented above are directly comparable since the plants were grown at the same station under similar conditions of climate and soil fertility. The water requirement is, as a rule, greatly influenced by the factors of the environment. If the conditions of either soil or climate are such as to retard growth, the effect will be shown in a higher water requirement. This will appear from the following discussion.

### SOIL FERTILITY.

Many experiments have been conducted to determine the effect of the fertility of the soil upon the water requirement of the crop grown in that soil. In highly productive soils the addition of fertilizers has little or no effect upon the water requirement. The soils employed by the writers in all experiments at Akron, for example, give as low a water requirement in their natural condition as they do with the addition of fertilizer. With a poor soil, however, the water requirement is often reduced one-half or even two-thirds by the addition of fertilizer, as is shown by the investigations of Montgomery and Kiesselbach.[1] They measured the water requirement of corn grown in an infertile soil, an intermediate soil, and a fertile soil. Their results are given in Table III, and show a great variation in the water requirement of corn when grown in the three types of soil without manure.

TABLE III.—*Water requirement of corn as influenced by soil fertility, according to Montgomery and Kiesselbach.*

| Soil. | Average dry weight per plant. | | Water requirement based on— | | | |
|---|---|---|---|---|---|---|
| | | | Total dry matter. | | Dry ears. | |
| | No manure. | Manure. | No manure. | Manure. | No manure. | Manure. |
| | *Grams.* | *Grams.* | | | | |
| Infertile | 113 | 376 | 550±16 | 350±8 | 2,136±436 | 692±45 |
| Intermediate | 184 | 414 | 479±11 | 341±4 | 1,160± 59 | 679±36 |
| Fertile | 270 | 473 | 392± 6 | 347±6 | 799± 39 | 683±18 |

[1] Montgomery, E. G., and Kiesselbach, T. A., Studies in Water Requirements of Corn, Nebraska Agr. Exp. Sta. Bul. 128, 15 pp., 1912.

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When manure was added, however, the water requirement was found to be the same in each type of soil.

This experiment and others of a similar nature show that transpiration and growth are not necessarily proportional, even under the same climatic conditions, and that the water requirement is profoundly affected by the plant food available in the soil.

### SOIL MOISTURE CONTENT.

A review of the literature shows many experiments relating to the effect of the water content of the soil on the water requirement of the crop. Many of these experiments were conducted in open pots and the evaporation from the soil estimated by means of check pots, which is an uncertain procedure. In experiments in which a certain number of pots are maintained at a high moisture content and others at a low moisture content, a serious error is also introduced through the unequal distribution of the water added. When the soils are kept at a low water content, the small amount of water required from time to time to bring the pot to its normal weight is sufficient to moisten only a comparatively small portion of the soil mass about the point of application. In effect, then, the plants in the low soil-moisture content series are grown in a very restricted mass of moist soil compared with plants grown with an optimum soil-moisture content. Plants grown in the dry soil series may therefore have a higher water requirement due to a deficiency in plant food rather than to any influence of the amount of moisture available. In order to overcome this difficulty, the writers have adopted the plan of growing a small plant in a large soil mass, to which no water is added during the period of growth. Data on such an experiment are presented in Table IV. The initial moisture content varied from 14.6 to 21 per cent. This represents about the maximum range in moisture content which can be employed in such an experiment with Akron soil. A moisture content below 14.6 per cent would not supply sufficient water to mature the plant, while with 21 per cent of water the soil is decidedly muddy. A consideration of the table will show that, while the total dry matter increased as the moisture content of the soil was increased, at least up to 17 per cent the water requirement was practically the same in all cases, the greatest difference being less than twice the probable error.

TABLE IV.—*The effect of different soil moisture contents on the water requirement of Turkey wheat.*

| | Percentage of soil moisture. | | | | |
|---|---|---|---|---|---|
| | 14.6 | 15.5 | 16.3 | 17.2 | 21.0 |
| Total dry matter | 109 | 123 | 138 | 186 | 185 |
| Water requirement based on total dry matter | 353±8 | 354±8 | 378±11 | 367±8 | 365±8 |

### EFFECT OF CLIMATIC FACTORS.

Numerous investigators have shown that the water requirement of plants is profoundly influenced by atmospheric factors. Experiments conducted during different portions of the same season or during different seasons, or at different places, seldom give the same result, due to the fact that the climatic conditions are not the same during the various experiments. This is well illustrated by the water requirement measurements at Akron, Colo., in 1911 and 1912. The summer of 1911 was hot and dry; while that of 1912 was unusually favorable,

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the latter being due largely to a marked reduction in solar radiation. The normal intensity of the sunlight at the earth's surface was reduced by about 20 per cent during the summer months of 1912—probably due to the presence of atmospheric dust from the eruption of Mount Katmai early in June. The evaporation during this same period was reduced by about 25 per cent, while the water requirement of 25 varieties at Akron (see Table V) was reduced 21 per cent.

TABLE V.—*Comparison of water-requirement measurements at Akron, Colo., in 1911 and 1912.*

| Crop. | Water requirement. | | Ratio, 1912 to 1911. |
|---|---|---|---|
| | 1911 | 1912 | |
| Wheat: | | | |
| Kubanka | 468±8 | 394±7 | 0.84±.02 |
| Bluestem | 531±5 | 451±4 | .85±.01 |
| Spring Ghirka | 506±3 | 457±3 | .90±.01 |
| Emmer | 534±14 | 428±3 | .80±.02 |
| Oats: | | | |
| Sixty-day | 605±5 | 491±13 | .81±.02 |
| Burt | 639±7 | 449±3 | .70±.01 |
| Canadian | 598±14 | 399±6 | .67±.02 |
| Swedish Select | 615±7 | 423±5 | .69±.01 |
| Barley: | | | |
| Hannchen | 527±8 | 443±3 | .84±.01 |
| Beldi | 543±2 | 416±4 | .76±.01 |
| White Hull-less | 542±3 | 439±1 | .81±.01 |
| Beardless | 544±9 | 403±8 | .74±.02 |
| Rye, spring | 724±7 | 496±9 | .69±.01 |
| Corn: | | | |
| Northwestern Dent | 368±10 | 280±10 | .75±.03 |
| Iowa Silvermine | 420±3 | 302±7 | .72±.02 |
| Esperanza | 319±5 | 239±3 | .79±.01 |
| Sorghum: | | | |
| Red Amber | 296±4 | 237±4 | .80±.02 |
| Milo, Dwarf | 333±3 | 273±4 | .82±.02 |
| Kafir, Blackhull | 278±5 | 250±5 | .93±.02 |
| Durra, White | 321±2 | 255±3 | .79±.01 |
| Kaoliang, Brown | 301±3 | 223±1 | .74±.01 |
| Millet, German | 263±15 | 248±7 | .94±.05 |
| Legumes: | | | |
| Alfalfa | 1,068±16 | 659±6 | .62±.02 |
| Clover, sweet | 709±9 | 638±4 | .90±.02 |
| Beet, sugar | 377±8 | 321±8 | .85±.03 |
| Mean water-requirement ratio, 1912 to 1911 | | | .79±.02 |
| Mean evaporation ratio for June, July, and August, 1912 to 1911 | | | .75±.03 |

The effect of climate on the water requirement is further illustrated by comparing the results obtained at Akron in 1911, 1912, and 1913, Table VI.

TABLE VI.—*Comparison of the water requirement of the same crops at Akron, Colo., 1911, 1912, and 1913.*

| | Water requirement. | | | Ratio. | |
|---|---|---|---|---|---|
| | 1911 | 1912 | 1913 | 1913 to 1911. | 1912 to 1913. |
| Wheat, Kubanka | 468±8 | 394±7 | 496±5 | 1.06 | 0.80 |
| Oats: | | | | | |
| Swedish Select | 615±7 | 423±5 | 617±9 | 1.00 | .69 |
| Burt | 639±7 | 449±3 | 617±5 | .97 | .73 |
| Corn: | | | | | |
| Northwestern Dent | 368±10 | 280±10 | 399±12 | 1.08 | .70 |
| Hopi | ..... | 285±7 | 358±8 | ..... | .80 |
| China White | ..... | 315±7 | 416±4 | ..... | .76 |

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TABLE VI.—*Comparison of the water requirement of the same crops at Akron, Colo., 1911, 1912, and 1913*—Continued.

| | Water requirements. | | | | |
|---|---|---|---|---|---|
| | | | | Ratio. | |
| | 1911 | 1912 | 1913 | 1913 to 1911. | 1912 to 1913. |
| Sorghum: | | | | | |
| Minnesota Amber | ..... | 239±2 | 298±2 | ..... | 0.80 |
| Red Amber | 298±4 | 237±4 | 296±1 | 0.99 | .80 |
| Millet, Kursk | ..... | 187±2 | 286±4 | ..... | .66 |
| Legumes: | | | | | |
| Alfalfa, Grimm | 1,068±16 | 657±11 | 834±8 | .77 | .79 |
| Pea, garden | 800±17 | ..... | 775±5 | .97 | ..... |
| Potato, Irish Cobbler | 448±11 | ..... | 659±15 | 1.47 | ..... |
| Cotton | ..... | 488±14 | 657±11 | ..... | .75 |
| Rice | ..... | 496±9 | 744±17 | ..... | .67 |
| Mean water-requirement ratio | ..... | ..... | ..... | 1.04±.04 | 0.75±.01 |
| Evaporation in inches for three summer months | 28.46 | 21.42 | 26.75 | .94±.04 | .80±.02 |

The condtions in 1911 and 1913 were so similar that crops grown during both years had in most instances practically the same water requirement. The mean water requirement of crops grown in 1912 was 75 per cent of the mean for the same crops in 1913.

### EVAPORATION.

The correlation between evaporation and water requirement obtained in the case of crops of alfalfa grown at four different stations in the Great Plains during the year 1912 is presented in Table VII. The stations here referred to are in a line extending from the Panhandle of Texas to northern North Dakota. It will be seen that the water requirement is highest in Texas and decreases as one passes to stations located farther north. In the last column of the table is given the ratio of the water requirement to the daily evaporation, from which it will be seen that a proportionality exists throughout a wide range in water requirement. In other words, the second crop of alfalfa grown at different stations on the Great Plains was found to have a water requirement varying directly with the daily evaporation rate from a free water surface at these stations.

TABLE VII.—*Water requirement of the second crop of Grimm Alfalfa at different stations in the Great Plains, 1912.*

| Location. | Growth period. | Days. | Water requirement. | Evaporation in inches. | Daily evaporation in inches. | Ratio of water requirement to daily evaporation. |
|---|---|---|---|---|---|---|
| Williston, N. Dak. | July 29–Sept. 16 | 47 | 518±12 | 7.5 | 0.159 | 33 |
| Newell, S. Dak. | Aug. 9–Sept. 24 | 46 | 630±8 | 8.6 | .187 | 34 |
| Akron, Colo. | July 26–Sept. 6 | 42 | 353±13 | 9.5 | .226 | 38 |
| Dalhart, Tex. | July 26–Aug. 31 | 36 | 1,005±8 | 11.0 | .306 | 34 |

It must not be concluded, however, that the water requirement is always proportional to the evaporation. The transpiration rate and the evaporation rate do not necessarily respond alike to a given change in environment. The water requirement is moreover dependent upon growth as well as transpiration, and

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an environment which is favorable to the growth of one crop plant may be unsuited to another. The results presented in Table VIII, which show the water requirement and transpiration for wheat and sorghum at Akron, Colo., and Amarillo and Dalhart, Tex., illustrate this point. The evaporation from a free water surface in northern Texas during the growth period of wheat and sorghum averaged 18 per cent above that at Akron, Colo. The water requirement of sorghum was practically the same in the two localities, while the water requirement of wheat averaged 36 per cent higher in northern Texas than in Colorado. This indicates that sorghum is relatively better adapted to the warmer, drier climate of northern Texas and that wheat is relatively better adapted to the cooler climate of Colorado.

TABLE VIII.—*Comparison of the relative evaporation and of the relative water requirement at two stations in the Great Plains in 1910 and 1911.*

| Station. | Year. | Crop. | Growing period. | Evaporation. | | Water requirement. | |
|---|---|---|---|---|---|---|---|
| | | | | Actual. | Relative. | Actual. | Relative. |
| Akron, Colo. | 1910 | Wheat | Apr. 18 to Aug. 2... | 27.7 | 100 | 664 | 100 |
| Amarillo, Tex. | | | Apr. 5 to July 19... | 34.0 | 122 | 853 | 128 |
| Akron, Colo. | 1910 | Sorghum | May 25 to Sept. 28.. | 33.0 | 100 | 356 | 100 |
| Amarillo, Tex. | | | May 10 to Aug. 28.. | 37.7 | 114 | 359 | 101 |
| Akron, Colo. | 1911 | Wheat | May 13 to Aug. 2... | 24.8 | 100 | 468 | 100 |
| Dalhart, Tex. | | | Apr. 25 to July 18.. | 28.5 | 115 | 673 | 143 |
| Akron, Colo. | 1911 | Sorghum | May 12 to Sept. 4... | 35.0 | 100 | 298 | 100 |
| Dalhart, Tex. | | | May 14 to Sept. 12.. | 41.9 | 120 | 313 | 105 |

HUMIDITY.

The effect of the humidity of the air on the water requirement is shown in Table IX. These measurements were made in two plant houses at Washington, D. C.; one kept dry and the other damp, the two houses being maintained as nearly as possible at the same temperature. It will be seen that in each instance the water requirement in the damp house was less than in the dry house, the first ranging from 66 to 80 per cent of the second. For seven of the nine crops tested the ratio falls within the limits 73 to 80 per cent. While the crop plants tested do not all appear to respond exactly alike to differences in the moisture content of the air, they all show under the same temperature conditions a marked increase in water requirement as the humidity is decreased.

TABLE IX.—*The effect of difference in air humidity on the water requirement, 1913.*

| Crop. | Water requirement. | | Ratio damp to dry. |
|---|---|---|---|
| | Damp house. | Dry house. | |
| Kubanka wheat | 836 | 1,052 | 79 |
| Hannchen barley | 758 | 1,037 | 73 |
| Spring rye | 875 | 1,100 | 80 |
| Burt oats | 760 | 1,042 | 73 |
| Grimm alfalfa | 906 | 1,378 | 66 |
| Kursk millet | 267 | 386 | 69 |
| Red Amber sorghum | 223 | 297 | 75 |
| Northwestern Dent corn | 210 | 263 | 80 |
| Honduras rice | 585 | 743 | 79 |

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The influence of relative humidity on the water requirement is further illustrated by the experiments of Montgomery and Kiesselbach[1] with corn. Two greenhouses were used, one of which was ventilated, while the other kept as humid as possible by moistening the floor and by using atomizers on the water system. Registering thermometers and hygrometers were used to record the temperature and humidity in each house and the evaporation from a free water surface was also measured. The results are summarized in Table X, from which it appears that in the dry house the water requirement of the corn was 56 per cent higher than in the humid house. It is also of interest to note that the evaporation in the dry house exceeded that in the humid house by the same amount, 56 per cent.

TABLE X.—*Relation of humidity and other factors to the water requirement of corn, according to Montgomery and Kiesselbach (1912, p. 4).*

| | Dry greenhouse. | Humid greenhouse. | Ratio humid to dry. |
|---|---|---|---|
| Mean temperature: | | | |
| 12 hours of night....° F.. | 80 | 75 | ..... |
| 12 hours of day....° F.. | 91 | 88 | ..... |
| Mean relative humidity: | | | |
| 12 hours of night....per cent.. | 48 | 72 | ..... |
| 12 hours of day....do.... | 37 | 58 | ..... |
| Total weight of 8 plants....grams.. | 670.36 | 861.77 | ..... |
| Average leaf area per plant....square inches.. | 1,079 | 1,070 | ..... |
| Total water used....kilograms.. | 227.785 | 184.230 | ..... |
| Water requirement: | | | |
| Based on dry weight....grams.. | 340 | 191 | 1.56 |
| Based on square inches of leaf area.... | 27.3 | 19.2 | 1.70 |
| Water evaporated from 36 square inches of free water surface..grams.. | 3,891 | 2,187 | 1.56 |

It is also possible to determine from Montgomery and Kiesselbach's data the relation of the saturation deficit to water requirement.[2] Other environmental factors being the same, the rate of evaporation from a free water surface would be approximately proportional to the saturation deficit. Since the transpiration at night is so small that it may be disregarded, it is necessary to compare only the saturation deficits in the two houses during the daylight hours. The ratio of these is 1.53 compared with 1.55 obtained by Montgomery and Kiesselbach as the ratio of the water requirement of corn in the two houses. Within the limits of these experiments, therefore, the water requirement of corn appears to be directly proportional to the saturation deficit.

### TEMPERATURE.

Temperature would be expected to have a marked influence on water requirement, since growth depends so largely upon suitable temperature conditions. The direct determination of the effect of temperature necessitates the use of controlled plant houses, in which all factors other than temperature are maintained as nearly as possible the same. Some measurements by the writers on the effect of temperature are presented in Table XI. The cold house was automatically maintained at a temperature of from 50° to 55° F., the warm house at about 80° F. The saturation deficit in the two houses was kept approximately the same by the use of atomizers in the water system of the warm house. The plants were grown continuously at the stated temperatures

[1] Studies in requirement of corn. Nebraska Agr. Exp. Sta. Bul. 128, 1912.

[2] Briggs, L. J., and Shantz, H. L., The Water Requirement of Plants—II. A Review of the Literature. Bureau of Plant Industry Bulletin 285, p. 65, 1913.

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from seed time until harvested. The crops grown fall naturally into two groups—the cool-weather crops, including wheat, barley, rye, oats, and alfalfa, and the warm-weather crops, corn, millet, rice, and sorghum. The water requirement of the first group in the cold house was less than one-half that in the hothouse, while the second group had a higher water requirement in the cold house than in the hothouse. Northwestern Dent, a variety of corn adapted to cool regions, showed little difference in the two houses. It is evident that rice and sorghum have a much higher temperature optimum than corn or millet and that these crops in turn have a higher optimum than the other small grains or than alfalfa. Millet required 61 per cent more water in the cold house than in the hothouse; rice, over 300 per cent; sorghum, over 500 per cent. This illustrates the great influence of temperature on the water requirement of different plants and emphasizes the fact that some plants are adapted to a high temperature and others to a low temperature. Other factors being the same, the lowest water requirement will be obtained at the temperature most suitable for the growth of the particular plant under consideration. In many plants this optimum changes with the plant's development.

TABLE XI.—*The effect of difference in air temperature on the water requirement, 1913.*

| Crop. | Water requirement. | | |
|---|---|---|---|
| | House I, 50–55° F. | House II, 80° F. | Ratio, cool to hot. |
| Cool-weather crops: | | | |
| Kubanka wheat | 385 | 826 | 0.47 |
| Hannchen barley | 298 | 758 | .39 |
| Spring rye | 423 | 875 | .48 |
| Burt oats | 403 | 760 | .53 |
| Grimm alfalfa | 429 | 906 | .47 |
| Hot-weather crops: | | | |
| Northwestern Dent corn | 249 | 210 | 1.19 |
| Kursk millet | 429 | 267 | 1.61 |
| Honduras rice | 2,566 | 585 | 4.39 |
| Red Amber sorghum | 1,236 | 223 | 5.54 |

SUMMARY OF WATER-REQUIREMENT DETERMINATIONS AS INFLUENCED BY CLIMATE.

From the above discussion, it appears that the range in the water requirement obtained by various investigators for the same crop is due, in large part, to difference in the climatic conditions under which the measurements were made.

TABLE XII.—*Summary of water-requirement determinations for different crops as influenced by climate.*[1]

| Crop. | Lawes, 1850, Rothamsted, England. | Wollny, 1876, Munich, Germany. | Hellriegel, 1883, Dahme, Germany. | King, 1892–1895, Madison, Wis. | Von Seelhorst, 1896–1898, Göttingen, Germany. | Widtsoe, 1909, Logan, Utah. | Leather, 1910–11, Pusa, India. | Briggs and Shantz, 1914, Akron, Colo. |
|---|---|---|---|---|---|---|---|---|
| Wheat | 235 | ..... | 359 | ..... | 333 | 546 | 554 | 513 |
| Oats | ..... | 665 | 401 | 541 | ..... | ..... | 469 | 597 |
| Barley | 258 | 774 | 297 | 388 | 365 | ..... | 468 | 534 |
| Rye | ..... | ..... | 377 | ..... | 386 | ..... | ..... | 685 |
| Corn | ..... | 233 | ..... | 350 | ..... | 386 | 337 | 368 |
| Sorghum | ..... | ..... | ..... | ..... | ..... | ..... | 437 | 322 |
| Millet | 447 | ..... | ..... | ..... | ..... | ..... | ..... | 310 |
| Beans | 214 | ..... | ..... | ..... | ..... | ..... | ..... | 728 |

[1] Summarized with respect to crops without respect to varieties. Includes only crops grown to maturity The reader will find a discussion of each investigation in "The water requirement of plants." Bul. 285 Bur. Plant Industry, U. S. Dept. Agr.

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TABLE XII.—*Summary of water-requirement determinations for different crops as influenced by climate*—Continued.

| Crop. | Lawes, 1850, Rothamsted, England. | Wollny, 1876, Munich, Germany. | Hellriegel, 1883, Dahme, Germany. | King, 1892–1895, Madison, Wis. | Von Seelhorst, 1896–1898, Göttingen, Germany. | Widtsoe, 1909, Logan, Utah. | Leather, 1910–11, Pusa, India. | Briggs and Shantz, 1914, Akron, Colo. |
|---|---|---|---|---|---|---|---|---|
| Peas | 235 | 416 | 292 | 477 | ..... | 843 | 563 | 788 |
| Clover (red) | 251 | ..... | 330 | 481 | ..... | ..... | ..... | ..... |
| Horse beans | ..... | ..... | 263 | ..... | ..... | ..... | ..... | 776 |
| Lupine | ..... | ..... | 373 | ..... | ..... | ..... | ..... | ..... |
| Chick-peas | ..... | ..... | ..... | ..... | ..... | ..... | 818 | 663 |
| Buckwheat | ..... | 646 | 371 | ..... | ..... | ..... | ..... | 578 |
| Rape | ..... | 912 | 337 | ..... | ..... | ..... | ..... | 743 |
| Mustard | ..... | 843 | ..... | ..... | ..... | ..... | 496 | ..... |
| Sunflower | ..... | 490 | ..... | ..... | ..... | ..... | ..... | 705 |
| Potatoes | ..... | ..... | ..... | 423 | 281 | ..... | ..... | 636 |
| Linseed | ..... | ..... | ..... | ..... | ..... | ..... | 807 | ..... |
| Eleusine | ..... | ..... | ..... | ..... | ..... | ..... | 263 | ..... |
| Paspalum | ..... | ..... | ..... | ..... | ..... | ..... | 312 | ..... |
| Cajanna | ..... | ..... | ..... | ..... | ..... | ..... | 635 | ..... |
| Cyamopsis | ..... | ..... | ..... | ..... | ..... | ..... | 598 | ..... |
| Rice | ..... | ..... | ..... | ..... | ..... | ..... | 811 | 710 |
| Sugar cane | ..... | ..... | ..... | ..... | ..... | ..... | 212 | ..... |
| Sugar beets | ..... | ..... | ..... | ..... | ..... | 497 | ..... | 397 |
| Alfalfa | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 881 |
| Sweet clover | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 770 |

In Table XII is given a comparison of the water-requirement measurements published prior to and including the year 1914.[1] Lawes, working in England, obtained the lowest water requirement ever reported for the particular crops he investigated. The results of Hellriegel and Von Seelhorst in Germany are relatively low, while Wollny's results are relatively high. King, working in Wisconsin, obtained lower values than the writers in northeastern Colorado. Widtsoe's results at Logan, Utah, agree closely with those of the writers, being from 4 to 7 per cent higher for most crops considered. Leather, at Pusa, India, obtained lower values for oats and barley, corn and peas, but higher values for wheat and sorghum than did the writers.

It appears from the data presented in this paper that where a crop is thoroughly adapted to the region in which it is grown the water requirement of that crop approaches its minimum, but where the crop is not well adapted the water requirement is relatively high. Water requirement is not correlated with any one condition of the environment, since plants respond differently to the varying factors of the environment. Cool-weather crops, as a rule, will have a low water requirement in cool seasons and a high water requirement in warm seasons; while with warm-weather crops the reverse usually holds, although the effect is less marked, due to the fact that a cool season is conducive to a low evaporation rate.

## RELATION BETWEEN QUANTITY OF IRRIGATION WATER USED AND QUANTITY OF CROP PRODUCED.

By JOHN A. WIDTSOE,

*President, University of Utah.*

It is probable that the world's present greatest agricultural problem is the utilization of the great arid and semiarid areas found on every continent and formerly known as the deserts of the earth.

[1] The data in this table are not strictly comparable. Open pots were employed in many instances, and in other respects the experimental procedure was not uniform.

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The agriculture which we know best has been developed under an annual rainfall of more than 30 inches and is especially adapted to humid conditions. However, 55 per cent of the earth's surface receives an annual rainfall of less than 20 inches. This is clear from the following table (8):

| Annual precipitation. | Proportion of earth's land surface. |
|---|---|
| | *Per cent.* |
| Under 10 inches (arid) | 25.0 |
| From 10 to 20 inches (semiarid) | 30.0 |
| From 20 to 40 inches (subhumid and humid) | 20.0 |
| From 40 to 60 inches (subhumid and humid) | 11.0 |
| From 60 to 80 inches (humid) | 9.0 |
| From 80 to 120 inches (humid) | 4.0 |
| From 120 to 160 inches (humid) | 0.5 |
| Above 160 inches (humid) | 0.5 |
| | 100.0 |

In North America the proportion of arid lands is very nearly that of the average for the earth. In South America the arid areas are relatively smaller; in fact, South America appears to be better supplied with rain than any other continent.

The larger half of the earth's surface, which lies under low rainfall, lower than that under which modern agriculture has been developed, must be reclaimed by dry farming or by irrigation. Dry farming is the application of scientific principles to the profitable production of useful crops without irrigation on lands that receive annually a rainfall of 20 inches or less. In districts of torrential rains, high winds, unfavorable distribution of the rainfall, the term "dry farming" is also properly applied to farming without irrigation under an annual rainfall of 20 or 30 inches. Irrigation is the artificial application of water to lands for the purpose of producing large and steady crop yields whenever the rainfall is insufficient to meet the full water requirements of the crops.

In the reclamation of an arid or semiarid region irrigation will probably be first attempted, for under irrigation large and steady crop yields are obtained, which become an effective insurance against failure.

Then, also, there are many localities under a rainfall so low that, with our present methods, irrigation alone can reclaim them. Dry farming, with its smaller acre yields, and requiring more careful methods of tillage, will usually follow irrigation. In time the two arts will move together for the reclamation of the earth's deserts.

However, irrigation can be made to serve a small part only of the area under a low rainfall. Dr. F. H. Newell has estimated, on the basis of very careful investigations, that in the United States, when the best reservoirs and canals have been built for the storage and delivery of water, not more than one-tenth of the dry land can be supplied with irrigation water from the existing streams, springs, and underground sources. Very probably like conditions prevail over the earth, owing to the insufficiency of the supply of irrigation water. Clearly, therefore, the problem of irrigation is smaller in actual area than that of dry farming, which must reclaim the remaining nine-tenths of the earth's thirsting lands if they are to be reclaimed.

Nevertheless the large and steady acre yields and the possibility of close settlement under the irrigation canal make irrigation tremendously important

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in the development of dry regions. Dry farming itself prospers best when in the neighborhood of irrigated districts. The important problem, then, in considering irrigation is the method whereby the relatively small supply of irrigation water can be made to serve the largest possible area of dry land. The importance of this problem is emphasized when it is remembered that water is stored in reservoirs and brought to lands at a very great cost, and that, therefore, as more land is served by a given quantity of water the lower the acre cost becomes and the more profitable the enterprise becomes. The problem becomes doubly important in view of the further fact that the more land is irrigated by a definite volume of water the more human beings can be fed and clothed from the land. To make irrigation water go as far as possible is undoubtedly the first problem in irrigation practice.

The fundamental importance of this problem has led to a number of careful investigations. The Utah Agricultural Experiment Station began work on this subject many years ago, first independently and later in cooperation with the irrigation investigations of the United States Department of Agriculture, of which Dr. Samuel Fortier is chief. Very definite and quite conclusive results have been obtained from the Utah work, which have recently been confirmed by several other stations. At the Utah station (Logan, Utah) small farms were laid out in small plats, along which ran water-tight troughs, through which water could be carried and accurately applied to the plats in accordance with the plans of the investigator. These pioneer farms have been used for the last 13 years for the study of the scientific foundation of irrigation practice. Many crops were used in the investigations, among them wheat, oats, barley, corn, timothy, Bromus inermis, orchard grass, Italian rye grass, alfalfa, sugar beets, carrots, potatoes, cabbage, and onions.

The first question to engage the attention of the Utah workers was as to the value, in irrigation, of the natural rainfall; that is, whether irrigation is a primary practice or supplementary to the natural precipitation. Experience had already shown that in years with wet springs and summers larger crops were obtained with the same canal flow than in dry years. On a double series of plats, therefore, the same crops were planted, but to one series irrigation water was applied, while the other was dry farmed. Under an annual rainfall of about 14 inches (at Logan, Utah) on the deep soils used in the experiments, it was found that from two-thirds to nearly nine-tenths of the crop produced on the moderately irrigated plats was really produced by the natural precipitation. Table 2 shows some of the results. (9, 10.) (See also fig. 1.)

TABLE 2.—*Per cent of a crop due to rain and soil water.*

| Crop. | Irrigation water applied (inches). | | Per cent due to rain and soil water. |
|---|---|---|---|
| | None. | 7.5. | |
| Wheat | 5,718 | 6,663 | 85.8 |
| Oats | 3,999 | 4,661 | 86.2 |
| Corn | 6,364 | 7,942 | 80.1 |
| Lucern | 5,540 | 7,608 | 72.0 |
| Potatoes | 1,940 | 2,900 | 67.0 |

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Similar results were obtained at the California Station (1) under the direction of Prof. Frank Adams, as shown in Table 3, and also by the Idaho Station (2, 7) under the direction of Don H. Bark and J. S. Welch, as shown in Table 3.

TABLE 3.—*Acre yields of crops with and without irrigation.*

CALIFORNIA RESULTS.

| Crop. | No irrigation. | About 7.5 inches irrigation. | Per cent of yield due to natural precipitation. |
|---|---|---|---|
| Wheat.....pounds.. | 3,340 | 5,424 | 61.6 |
| Barley.....do.... | 3,366 | 5,865 | 57.4 |
| Corn.....tons.. | 4 | 6.22 | 64.3 |
| Alfalfa.....do.... | 4.42 | 5.90 | 74.9 |

IDAHO RESULTS.

| Crop. | Not irrigated. | About 7.5 inches irrigation. | Per cent due to irrigation. |
|---|---|---|---|
| Wheat.....bushels.. | 10.47 | 21.11 | 49.6 |
| Potatoes.....pounds.. | 3,465 | 3,838 | 90.2 |

These significant findings may be summed up in the principle that irrigation is a supplementary practice and should always be supplementary to the natural precipitation. Necessarily, then, the quantity of water used in irrigation should be varied with the quantity of water that falls from the heavens. In a wet year little and in a dry year much irrigation water should be used. True, where the annual rainfall is very low or poorly distributed or on shallow soils, irrigation practice approaches that of a primary art. In most places, however, the rainfall is sufficient to produce, with proper dry-farm methods, fair crop yields, and in all such localities irrigation should supplement the rainfall and should vary with it. In accordance with this principle, irrigation should be practiced in humid regions only in times of drouth, for in ordinary seasons the addition of irrigation water to lands under a high rainfall seldom increases the yield profitably. As an insurance against dry years, the small irrigation plant may be found of high value on humid farms.

The supplementary nature of irrigation practice, having been established, the Utah workers next undertook to determine the effect of applying different quantities of water on lands under a given annual rainfall. The results obtained may be definitely expressed in what may well be called the first law of irrigation practice. The crop-producing power of each unit of irrigation water diminishes as the total quantity of water used is increased. That is, if 5 inches of irrigation water produce a certain weight of crop, 10 inches will produce less than double this quantity, and the more water used the smaller proportionally becomes the yield. Some of the many results obtained in the Utah work (10) are shown in Tables 4 and 5. (See also figs. 2–5.)

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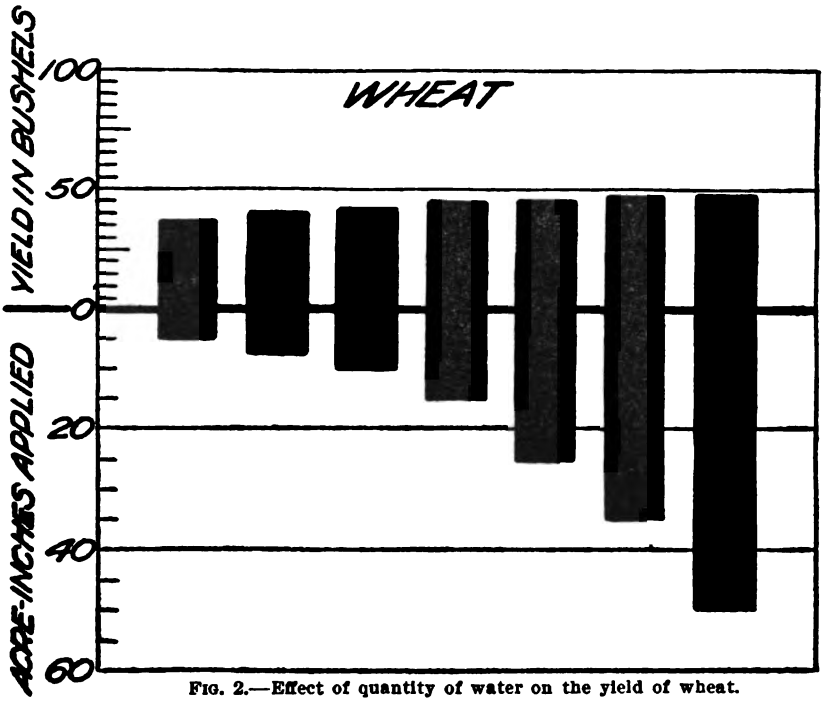


FIG. 2.—Effect of quantity of water on the yield of wheat.

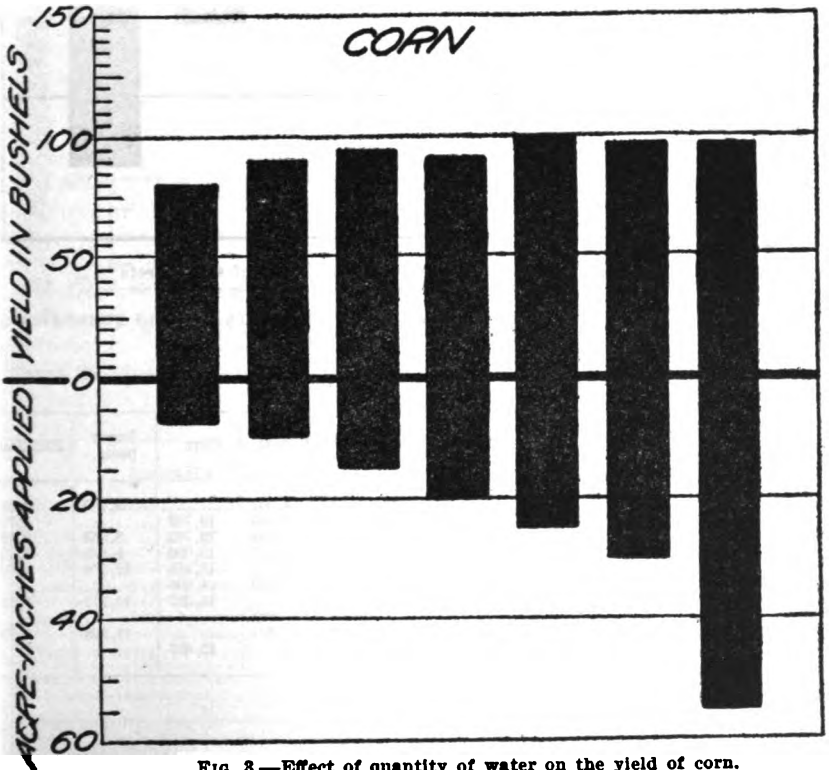


FIG. 3.—Effect of quantity of water on the yield of corn.

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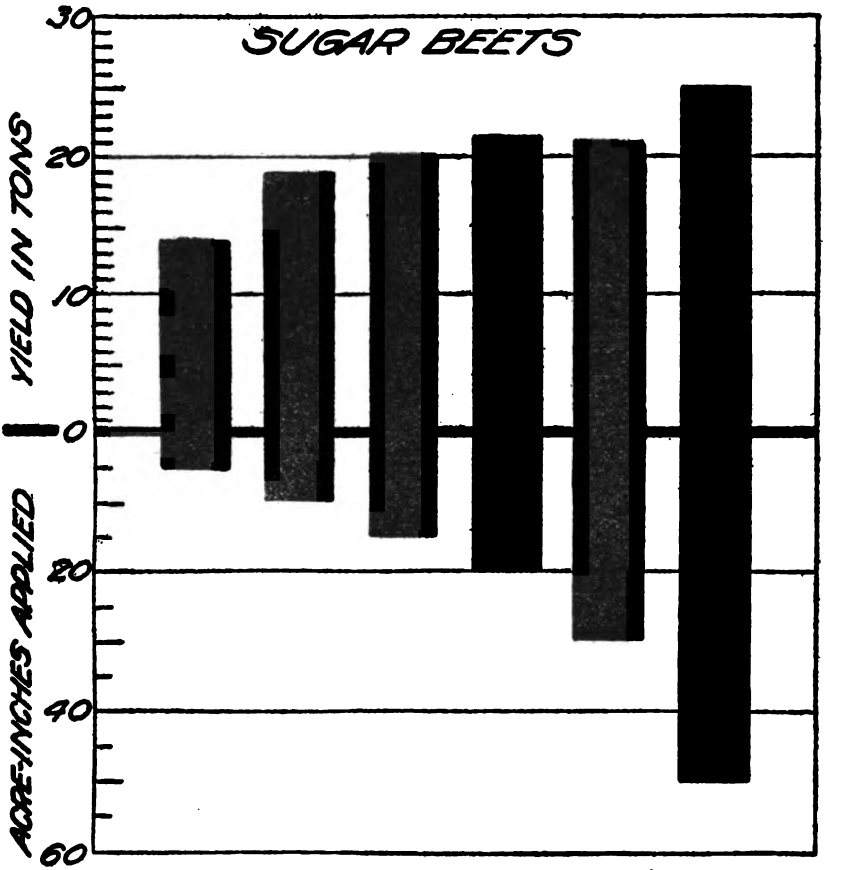


FIG. 4.—Effect of quantity of water on the yield of sugar beets.

TABLE 4.—*Yields of dry matter, in pounds per acre, with varying quantities of water. (Utah results.)*

[Rainfall and soil water=13.74 inches.]

| Inches of water applied. | Wheat. | Corn. | Sugar beets. | Potatoes. |
|---|---|---|---|---|
| 5.0 | 4,969 | ..... | 6,080 | 2,310 |
| 7.5 | 5,545 | 10,757 | ..... | 2,730 |
| 10.0 | 5,684 | 12,762 | 8,053 | 2,926 |
| 15.0 | 6,279 | 13,092 | 8,636 | 3,405 |
| 20.0 | ..... | 13,865 | 10,076 | 4,005 |
| 25.0 | 6,672 | 14,606 | ..... | ..... |
| 30.0 | ..... | 15,295 | 10,271 | 3,660 |
| 35.0 | 7,229 | ..... | ..... | ..... |
| 50.0 | 7,999 | ..... | 11,528 | 3,795 |
| 55.0 | ..... | 12,637 | ..... | ..... |

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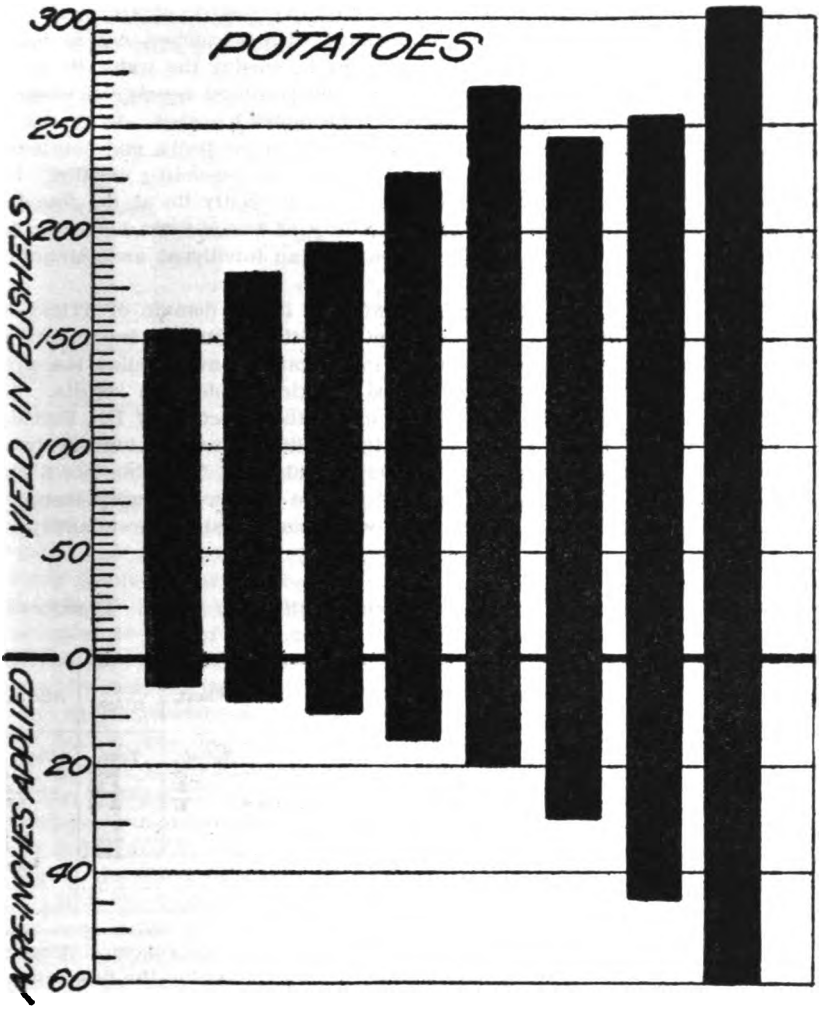


FIG. 5.—Effect of quantity of water on the yield of potatoes.

TABLE 5.—*Acre yields of crops with varying quantities of water.* (*Utah results.*)

[Rainfall and soil water=13.74 inches.]

| Inches of water applied. | Wheat. | Corn. | Sugar beets. | Potatoes. | Alfalfa. |
|---|---|---|---|---|---|
| | *Bushels.* | *Bushels.* | *Tons.* | *Bushels.* | *Tons.* |
| 5.0 | 37.8 | ..... | 13.8 | 74.8 | ..... |
| 7.5 | 41.5 | 79.1 | ..... | 74.7 | ..... |
| 10.0 | 43.5 | 80.5 | 18.6 | 77.9 | 4.9 |
| 15.0 | 45.7 | 93.9 | 19.5 | 82.1 | 3.8 |
| 20.0 | ..... | 91.6 | 21.3 | 80.6 | 4.5 |
| 25.0 | 46.5 | 99.2 | ..... | 80.2 | 4.6 |
| 30.0 | ..... | 97.1 | 20.8 | 79.8 | 4.4 |
| 35.0 | 48.5 | ..... | ..... | ..... | ..... |
| 50.0 | 49.4 | ..... | 24.5 | 79.5 | 5.4 |
| 55.0 | ..... | 96.8 | ..... | 76.9 | ..... |

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In the case of wheat the total acre yield of dry matter obtained with 5 inches of water was practically 5,000 pounds; with 50 inches, nearly 8,000 pounds were obtained. The increase in yield by increasing the water 10 times was less than twofold. With 5 inches, each inch produced nearly 7.6 bushels of wheat; with 50 inches, each inch produced not quite 1 bushel. As shown in the tables, similar results were obtained with corn, sugar beets, and potatoes; and every other crop subjected to study yielded corresponding results. So important is this law that if accepted it must of necessity lie at the foundation of all future irrigation practices. The duty of water must hereafter be formulated for all nations and all countries upon an intelligent understanding of this principle.

When this law was first expressed the workers in the domain of irrigation were not certain that it should be accepted without further investigation. During the last decade, however, several investigators have studied the subject, and, without exception, have obtained practically identical results. As an example, Prof. Frank Adams, working under the direction of Dr. Fortier, at the University of California, has recently published results obtained from such work at the experimental farm at Davis, Cal. (1) In Table No. 6 the results obtained with wheat, corn, and alfalfa are shown. In every instance the crop-producing power of the irrigation water decreased as the quantity of water used increased.

TABLE 6.—*Acre yields of crops with varying quantities of water. (California results.)*

| Depth of water applied (inches). | Wheat. | Corn silage. | Alfalfa. |
|---|---|---|---|
| | *Bushels.* | *Tons.* | *Tons.* |
| 6 | 19 | 7.48 | ..... |
| 12 | 25 | 8.52 | 5.90 |
| 18 | 17 | 8.42 | 7.04 |
| 24 | ..... | ..... | 7.81 |
| 30 | ..... | ..... | 9.12 |
| 36 | ..... | ..... | 9.40 |
| 48 | ..... | ..... | 9.43 |
| 60 | ..... | ..... | 9.19 |

Bark and Welch carried on similar experiments at the experiment station at Gooding, Idaho (2, 7), and likewise obtained results confirming the first law of irrigation. The Idaho results are shown in Table 7.

TABLE 7.—*Acre yield of crops with varying quantities of water. (Idaho results.)*

| Depth of water applied (inches). | Winter wheat. | Spring wheat. | Potatoes. | Alfalfa. |
|---|---|---|---|---|
| | *Bushels.* | *Bushels.* | *Bushels.* | *Tons.* |
| 5.0 | ..... | 21.1 | ..... | ..... |
| 7.5 | 30.4 | ..... | ..... | ..... |
| 10.0 | ..... | 25.2 | 105 | 3.78 |
| 12.5 | 27.8 | ..... | ..... | ..... |
| 15.0 | ..... | 28.2 | ..... | ..... |
| 17.5 | 30.6 | ..... | ..... | 4.42 |
| 22.5 | ..... | 31.2 | 234 | ..... |
| 25.0 | ..... | ..... | ..... | 5.31 |
| 27.5 | ..... | 31.7 | ..... | ..... |
| 30.0 | ..... | ..... | ..... | 5.60 |
| 35.0 | ..... | 21.1 | 226 | 6.60 |
| 45.0 | ..... | ..... | ..... | 6.81 |

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In 1911 much of the Utah work was placed in other hands. Dr. F. S. Harris undertook the study of the water requirements of corn. In Table No. 8 the results of the work are shown (4).

TABLE 8.—*Effect per acre of irrigation water on the yield of grain and stover of corn. Average of three manuring treatments.*

| Water applied. | Plats each year. | 1911 | | 1912 | | 1913 | | Average. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Grain. | Stover. | Grain. | Stover. | Grain. | Stover. | Grain. | Stover. |
| | | Bush. | Tons. | Bush. | Tons. | Bush. | Tons. | Bush. | Tons. |
| None | 6 | 45.19 | 1.81 | 39.20 | 3.05 | 57.00 | 3.04 | 47.13 | 2.63 |
| 5 inches | 6 | 55.93 | 2.07 | 42.50 | 3.31 | 59.75 | 4.06 | 52.73 | 3.15 |
| 10 inches | 6 | 61.07 | 2.15 | 33.80 | 2.89 | 60.40 | 4.24 | 51.76 | 3.09 |
| 20 inches | 6 | 71.86 | 2.52 | 39.20 | 3.98 | 65.76 | 4.43 | 58.94 | 3.64 |
| 30 inches | 6 | 75.10 | 2.98 | 40.07 | 4.32 | 55.50 | 3.95 | 56.89 | 3.75 |
| 40 inches | 6 | 73.70 | 3.14 | 39.50 | 4.22 | 59.50 | 3.89 | 57.60 | 3.75 |

The work reported in table No. 8 was done on the Greenville farm and on the plats on which the original work had been done. It is interesting therefore to note that practically identical results were obtained there by different workers. The experiment stations of New Mexico, Nevada, Wyoming (5), and Montana, and some other States have done some work on this subject, which in every instance confirms the fundamental law of irrigation practice.

In view of this confirmatory work the first law of irrigation practice may be accepted as resting on sound experimental evidence. That the metes and bounds of the law are yet to be fixed goes without question. It has as yet been stated only in its rough outlines, and must be more clearly defined by further and more elaborate investigations.

The farmer was formerly advised to avoid the excessive use of irrigation water, because it would water-log the land. Now he is advised to use water sparingly, because large quantities of water mean a diminution of the crop-producing power of irrigation water. If water is used to excess, as may be observed in the quoted experiments, not only do the crop yields decrease in proportion to the water used but at length there is an actual diminution of crop yield. It is the business of the irrigation farmer who understands the diminishing crop value of water so to control and limit the quantity of water applied to his crops that he may obtain the greatest possible returns from his investment in land, water, labor, and irrigation system.

The irrigation work of the experiment stations in the western United States has brought out numerous important relationships among water, soils, and crops. These make possible an explanation of the law which has just been discussed. The water solution which the plant draws from the soil contains the indispensable mineral plant foods. The soil solution is held chiefly as a thin film around the soil particles, and partly in a loose combination with colloidal substances derived from organic matter and certain inorganic substances. To abstract the water so held and to pass it through the plant until it evaporates from the leaves requires the expenditure of considerable energy. The thinner the soil water film the greater the resistance encountered by the plant as it absorbs the solution; the thicker the film the more easily is the water secured. In other words the less water in the soil the greater is the difficulty with which it is secured; the more water in the soil the more readily is it absorbed. The plant does not seem to possess the power of regulating the quantity of water it takes up; in fact it has been demonstrated that the quantity of water taken from the soil by a plant varies directly with the quantity



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of water found in the soil. Moreover it is believed that the concentration of the soil solution is proportional to the quantity of water in the soil—that is, practically, to the thickness of the soil water film. It follows that whenever there is much water in the soil more water must be absorbed to supply the plant with the mineral plant food necessary for a given development and growth, and, consequently, there is a larger waste of water in proportion to the plant substance produced. When the water in the soil is in such excess as to fill the soil pores the plant attempts to rid the soil of the excess moisture by passing it rapidly through its own structure into the air. Under such conditions a plant is practically a pumping system, and growth is not only retarded but frequently much of the stored energy of the plant is consumed in the work of pumping. Under such conditions there is no further increase in crop yield.

Of course, other factors also contribute to accentuate the decreasing crop-producing power of irrigation water as the quantity of water is increased. Under the most favorable methods of practical irrigation, much water is lost by direct evaporation into the air. The more water is used the longer the soil remains moist and the greater the quantity of water lost by evaporation. When excessive quantities of water are used, much of the water sinks below the reach of plant roots, and the more water used, the greater the loss by seepage. Though evaporation and seepage may render valueless to plants much of the water added to crops, yet these factors do not explain the first law of irrigation. The relation between the water-absorbing power of the plant and the thickness and nature of the soil water film, appears to remain as the chief factor in explaining the first law of irrigation practice.

Many very important deductions may be made from the first law of irrigation practice, as here stated:

First. The value of the natural precipitation should be kept in mind. In all irrigated districts more care should be given to the use of the natural precipitation. Dry-farming methods should be employed to enable the rain and snow water to enter the soil and to retain such stored water in the soil. At this point dry farming and irrigation meet on the same tract of land.

Second. The quantity of irrigation water to be applied on the land should be varied in accordance with the natural precipitation stored in the soil. The heavier the rainfall, the smaller the necessary quantity of irrigation water, and vice versa. There is no absolute duty of water for all the world.

Third. The varying crop-producing power of irrigation water must cause the farmer to seek the highest point of value in the use of irrigation water. It does not follow that because the crop-producing power of water diminishes with every added inch that the farmer should add the smallest quantity of water to his fields. The cost of production, including all the operations necessary to produce the crop, must be considered in determining, under the first law of irrigation practice, the proper quantity of water to use. Adams, in the California work (1) summarized in table No. 7, has shown that by the application of 30 inches of water the net acre profit on alfalfa was the highest. The value of the hay increased up to 48 inches, but, considering the costs involved, 30 inches proved to be the most profitable. Similar calculations may be made for any crop, when the effect of varying quantities of water is known. The point of highest return, considering the value of the land and water and the labor applied in the production of the crop, should be determined for all irrigated localities. With the knowledge now in our possession this should be a relatively easy matter for the irrigation managers or Government investigators to determine.

From the point of view of nations, however, even the immediately most profitable acre crop need not be of the greatest importance. The policy of a

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country with a large area of arid or semiarid land must be to settle and to bring under cultivation the largest possible part of this area. Besides the total food supply of the world will ever be more important than the highest acre yield on limited areas. The world must provide against the feeding of an increasingly large population. The present outlook of the great nations might have been more peaceful had there been a more abundant supply of cheap foodstuffs with which to supply the teeming millions. It is not a far guess to suggest that the universal peace, of which we are dreaming, may come about, largely at least, through the reclamation of the great deserts for agricultural purposes and by the cheapening of agricultural processes whereby food and clothing may become more easily accessible to mankind. In any case the present problem before humanity is not so much to make the production on one acre a trifle larger or more profitable as to enlarge the producing domain, whether under humid or arid conditions.

With this thought in mind some interesting calculations have been made on the basis of the data presented in this paper. For instance, in several of the Western States the State engineers allow the farmers to use approxi-

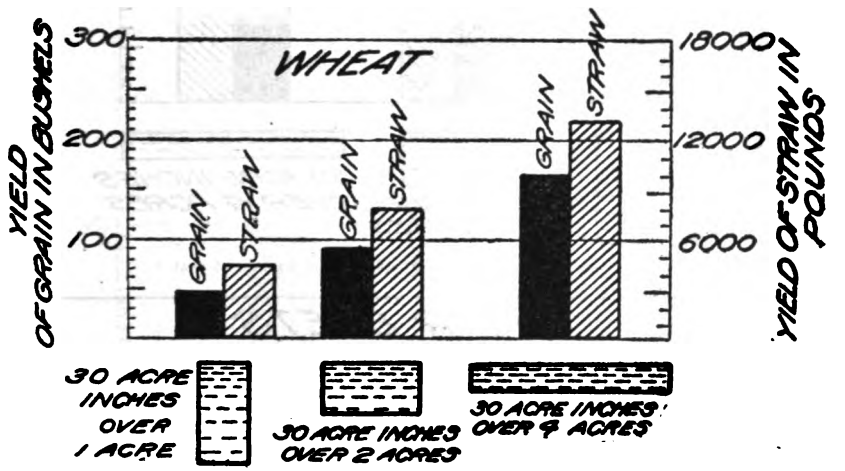


FIG. 6.—Wheat-producing power of 30 acre-inches of water.

mately 30 acre-inches of water in the production of ordinary crops. It is possible to produce crops with less water than this, and the better farmers use less, but the average farmer uses all that is available to him. If now the farmer spreads the 30 acre-inches allowed him over 1, 2, 3, 4, or 5 acres, some very interesting results follow. With the use of the data obtained in the Utah work on the irrigation of wheat (9) the following table has been prepared (No. 9). It shows how 30 acre-inches of water may be made to produce different quantities of grain and straw when spread over 1 to 6 acres (see also figs. 6–9):

TABLE 9.—*Crop-producing power of 30 acre-inches of water when spread over different areas.*

| | 1 acre. | 2 acres. | 3 acres. | 4 acres. | 6 acres. |
|---|---|---|---|---|---|
| Grain (bushels) | 47.51 | 91.42 | 130.59 | 166.16 | 226.16 |
| Straw (pounds) | 4,532 | 2,908 | 10,256 | 13,204 | 17,916 |

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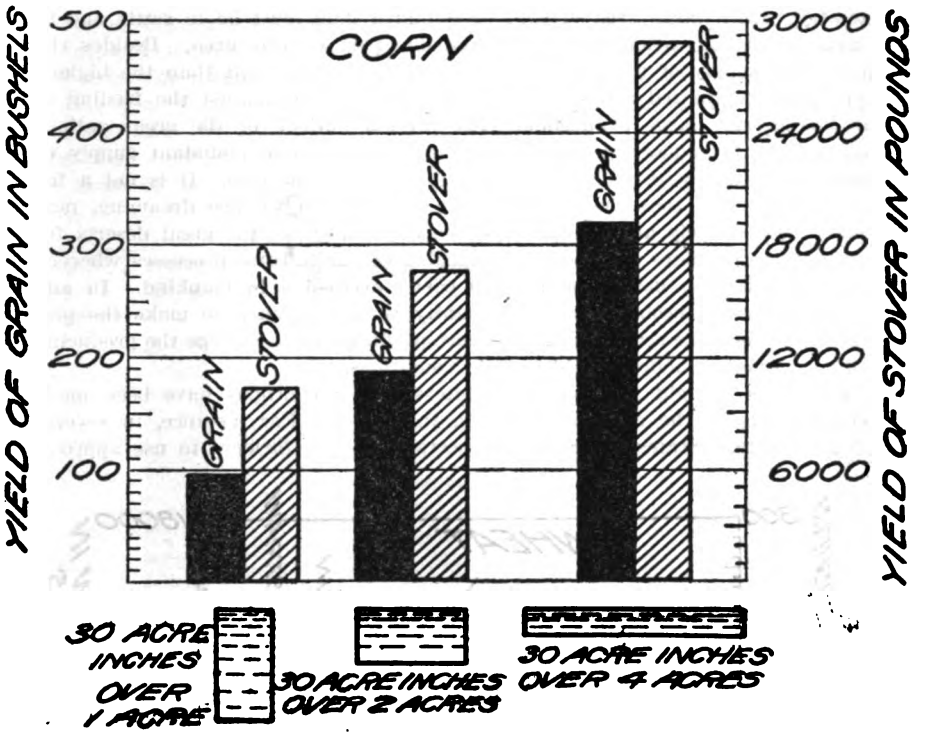


FIG. 7.—Corn-producing power of 30 acre-inches of water.

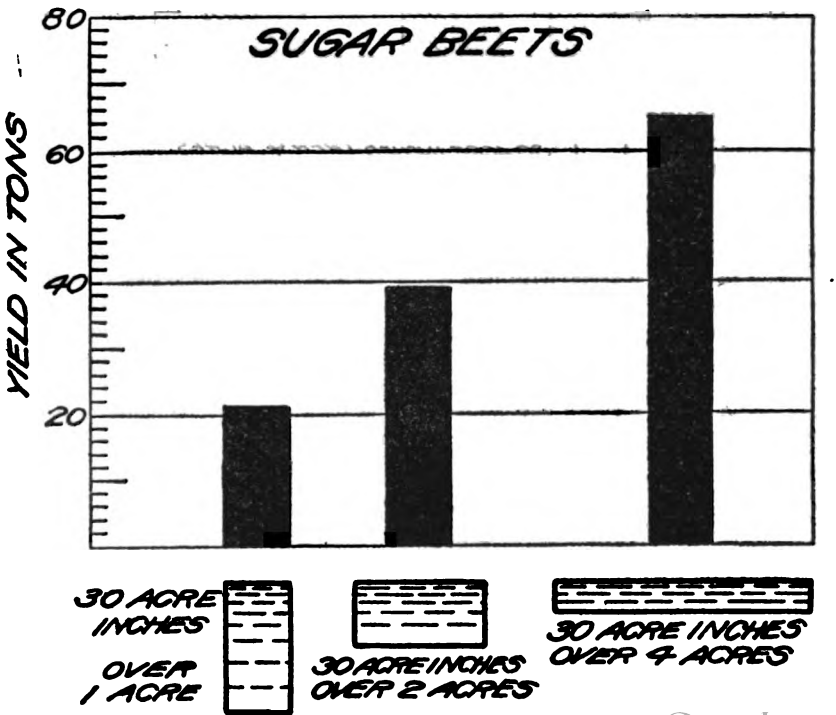


FIG. 8.—Sugar-beet producing power of 30 acre-inches of water.

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When 30 acre-inches of water were spread over 6 instead of over 1 acre, the total yield of wheat was increased from 48 bushels to 226 bushels of grain, and from 4,500 to 18,000 pounds of straw—that is, fourfold. In the final establishment of empires on arid soils this fundamental relationship of water and crop yield must be considered. Given a large area of land under a low rainfall, and a limited quantity of flowing water, the way to find homes for many families and to produce the largest quantity of foodstuffs for the human race will be to spread the water just as far as possible over the land. To what ex-

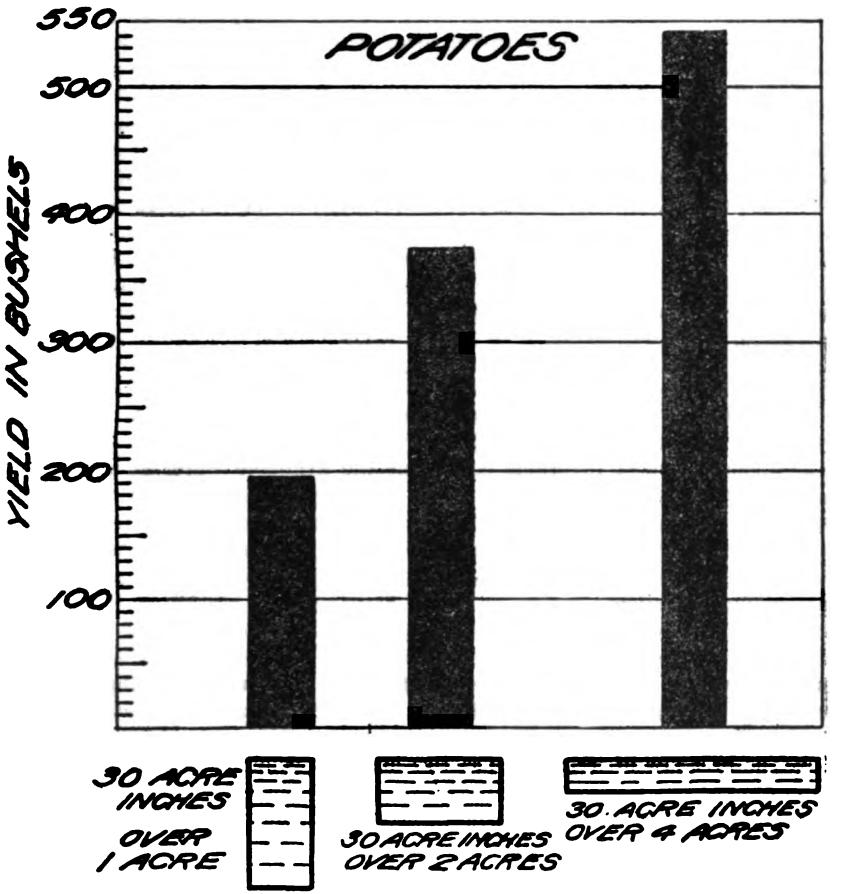


FIG. 9.—Potato-producing power of 30 acre-inches of water.

tent this may be done will depend upon local conditions; but the problem must not be overlooked in the reclamation of the great desert empires of which every country in the world possesses a part. Usually it is even financially the best thing to do, although the money return is only one of many considerations in a problem of this kind. In the following table (No. 10), under Utah conditions, the financial returns from the use of 30 acre-inches spread over 1, 2, 3, or 4 acres of sugar beets are shown (9).

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TABLE 10.—*Net income from crops and a fixed quantity of water.*

| 30 acre-inches spread over— | Inches of water on each acre. | Yield of beets per acre. | Total yield of beets. | Price paid for ton of beets. | Gross income from beets. | Cost per acre. | Total cost. | Net income from beets. |
|---|---|---|---|---|---|---|---|---|
| | | *Tons.* | *Tons.* | | | | | |
| 1 acre | 30.0 | 21.0 | 21 | $5 | $105 | $60 | $60 | $45 |
| 2 acres | 15.0 | 19.5 | 39 | 5 | 195 | 60 | 120 | 75 |
| 3 acres | 10.0 | 18.6 | 56 | 5 | 280 | 60 | 180 | 100 |
| 4 acres | 7.5 | 16.3 | 65 | 5 | 325 | 60 | 240 | 85 |

When 30 acre-inches were spread over 3 acres there was a much larger financial return than when the same quantity was spread over more or fewer acres. Similar calculations may be made for all of the crops studied.

Undoubtedly, as time progresses, we shall learn more and more definitely the limits of the economical use of irrigation water. It is likely that the irrigation farmer will use less and less water in the production of crops until we shall wonder, with a sort of economic horror, at the wasteful use of water which has characterized the beginnings of modern irrigation. As this change comes we shall find it to rest more and more definitely on the first law of irrigation practice, as here developed, that "the crop-producing power of each unit of irrigation water diminishes as the total quantity of water used is increased."

## SUMMARY.

1. One-half of the earth's surface lies under a low rainfall, which can be reclaimed only by irrigation and dry farming.

2. Under the most favorable conditions the available water supply in arid and semiarid regions will irrigate only about one-tenth of the available land. The economical use of water will therefore extend the irrigated area.

3. Irrigation practice should always be supplementary to the natural precipitation. When the rainfall is carefully stored in the soil less water is needed for irrigation.

4. The more water is used in the irrigation of an acre of land the smaller the crop yield for each unit of water used. This is the first law of irrigation practice, which may be expressed as follows: The crop-producing power of each unit of irrigation water diminishes as the total quantity of water used is increased.

5. The first law of irrigation practice has been confirmed by several investigators.

6. Overirrigation should be avoided, because it injures the land and because it reduces the possible crop yield.

7. The first law of irrigation seems to result from the fact that plants do not possess the power of regulating the quantity of water taken from the soil. The more water in a soil the more will the plant absorb.

8. It does not follow from the first law of irrigation practice that the farmer should use the least possible quantity of water. For every crop, under definite conditions of soil, climate, labor conditions, etc., there is a quantity of water which yields the highest profit per acre. This point is usually between the lowest and highest quantities of water used in actual practice.

9. By using water more economically, even if the acre profit is diminished, more land is reclaimed, more foodstuff produced, and thus more lives satisfied. Probably the reclamation of many acres will determine the use of the first law of irrigation practice.

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10. The irrigation practice of the future must rest upon the recognition of the first law of irrigation practice as stated in this paper.

LITERATURE CITED.

(1) Adams, Frank, Progress Report of Cooperative Irrigation Investigations in California. California Department Engineering, Fourth Annual Report (1915).

(2) Bark, Don H., Duty of Water Investigations. Report Idaho State Engineer for 1914 (1915).

(3) Fortier, Samuel, Duty of Water in Irrigation. International Engineering Congress (1915).

(4) Harris, F. S., Irrigation and Manuring Studies. Utah Experiment Station. Bulletin No. 133 (1914).

(5) Nowell, H. T., Irrigation of Barley. Wyoming Experiment Station. Bulletin No. 77 (1908).

(6) True, G. H., and Peterson, F. L., Cooperative Irrigation Investigations. Annual Report, Nevada Experiment Station for 1910–11 (1912).

(7) Welch, J. S., Irrigation Practice. Idaho Experiment Station. Bulletin No. 78 (1914).

(8) Widtsoe, J. A., Dry Farming. Macmillan & Co. (1911). Le Dry Farming, Culture des terres seches. Librairie de la Maison Rustique, Paris (1912).

El Dry Farming 'o Cultivo de Secano. Liberia Gutenberg de Jose Ruiz, Madrid (1914).

(9) Widtsoe, J. A., The Principles of Irrigation Practice. Macmillan & Co. (1914).

(10) Widtsoe, J. A., The Production of Dry Matter with Different Quantities of Irrigation Water. Utah Experiment Station. Bulletin No. 116 (1912).

(11) Widtsoe, J. A., and Merrill, L. A., The Yields of Crops with Different Quantities of Irrigation Water. Utah Experiment Station. Bulletin No. 117 (1912).

## ADAPTATION OF METHODS OF APPLYING WATER TO SOILS.

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There are several methods of applying water to soils used in the irrigated portions of the United States. Each of these has been adapted and developed to fit some of the varying conditions which occur there. Owing to the many and varying factors which influence the method used, no one method can be best suited for all conditions. It is probable that, as the irrigation practice is studied and improved, additional methods or further modifications of present methods will be developed. The subject matter of this paper will be limited to a discussion of practice in the western United States.

In choosing the method of irrigation to be used in a particular case, the purpose of irrigation should be kept clearly in mind. The water applied to soils is disposed of in four ways—by plant transpiration, deep percolation, surface evaporation, and surface run-off or waste. Of these only the first is

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directly used in crop production. The purpose of irrigation is to so apply water to the soil that the crop may secure sufficient moisture for profitable yields. The extent to which the water applied is used by the plants is a measure of the efficiency of the method of application. Improvements in irrigation practice are mainly designed to reduce the last three items mentioned. A reduction of these items which represent moisture losses results in a reduction in the cost of water and the labor of its application.

In order that the percolation, evaporation, and waste may be reduced it is necessary that no more water be applied than can be held by the soil; that either the exposed surface from which evaporation can take place be reduced or that preventive methods be used on the moist surface; and that the water be so well controlled that waste can be prevented. Where water is of sufficient value, surface waste can practically be eliminated. Evaporation losses can be reduced but not entirely prevented. Deep percolation losses can be very nearly prevented, except on some extreme types of soil. The losses from percolation are not so easily proven as in the case of evaporation and waste, and their extent probably is only partially realized by the average farmer. A better knowledge of the amount of deep percolation will lead to better practices for its prevention.

If irrigation is to be practiced so as to prevent deep percolation losses, the depths applied at each irrigation should not exceed the amounts required to replenish the soil moisture within the reach of the plant roots. This amount depends on the kind of soil rather than on the kind of crops and makes the soil the most important factor in the selection of the method of applying water to be used in any case. Other important factors to be considered are: Crops; topography of land; climate, particularly as affecting the length of growing season, crops which can be raised, and rainfall; character of water supply; value of land, water, and crop, particularly as affecting the cost which can be incurred for improvements in practice; and the type of farmer.

In this discussion a knowledge of the different general methods used in applying water to soils in the United States will be assumed. Information regarding these can be secured in various Government bulletins and in books on the subject by different authors. It may be well, however, to briefly discuss the more generally used methods before taking up the conditions for which each is best adapted.

The following seven methods are usually recognized as being more or less distinct and as covering present practice: Free flooding, border or strip checks, square checks, contour checks, basins, furrows or corrugations, and surface pipe.

Free flooding is used on a larger area than all others combined. It is the oldest method, originally adopted when water was of low value and crop prices generally high. In free flooding the method is fitted to the land rather than the land to the method, thus making the cost of preparing the land low. For this reason it is particularly well adapted to new projects. In free flooding the stream of water is conveyed onto the field in ditches from which the water is allowed to spread by flooding, its direction of flow being determined by the slope of the lands. By a proper location of the ditches and by turning the water out at a sufficient number of points the whole area can be covered.

In border or strip checks the flooding is controlled by parallel dikes across the fields, which guide the water in narrow strips, enabling larger heads and longer runs to be used. Its use is more general in California and the Southwest than in the other States.

The square and contour checks and the basin methods are variations of the same general principle. The land is divided into separate areas of different

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size and shape in these methods, but all for the same general purpose. These areas are surrounded by ridges or dikes, which are used to hold the water within the area as desired. In the square-check system the areas are either square or rectangular, the land within each check being leveled to a uniform elevation or to give a slight fall across the check. In the contour-check system the shape of the checks is irregular and is made to fit the slope of the land, the area within the checks being level or nearly level. The basin method is a modification of the square check used mainly in orchard irrigation. The checks are made sufficiently small so that leveling within the dikes is not required on usual slopes.

Furrow irrigation consists in carrying the water across the land in furrows. In all other methods all of the surface soil is covered; in furrows only the area of the furrows actually comes in contact with the water. Corrugations are furrows used in general field crops, where the corrugations are comparatively permanent. In furrow irrigation of orchards the furrows are usually destroyed by the cultivation which generally follows each irrigation.

The surface-pipe method is a form of free flooding in which the water is conveyed to small areas of the field by means of portable slip joint pipe, thus reducing the distance which the water floods over the surface.

The following estimate has been made on the extent to which these different methods are used in the United States. This estimate is based on the areas irrigated in each State and an estimate for each State of the proportion irrigated by each method. It is only approximate, but indicates the relative importance in area of the different methods.

Estimated percentage of irrigated area in the United States irrigated by each method:

| | |
|---|---|
| Free flooding | 55 |
| Border checks | 12 |
| Square checks | 5 |
| Contour checks | 5 |
| Basins | 2 |
| Furrows | 20 |
| Surface pipe | 1 |

## SOIL.

As previously stated the soil is the most important factor in determining the method of irrigation to be used. The most important factor in a given soil is its moisture holding capacity. The importance of judging the efficiency of each irrigation by the resulting effect on the soil moisture as well as on the crop yield is becoming better recognized. The usual soil classification is based on mechanical analysis. When soils are classified for irrigation purposes a further basis is required. In mechanical analysis of soils several different sizes of soil grains are recognized. The term used to describe a soil depends on the proportion in which the different sizes of soil grains occur. However, as the proportion of the several different sizes varies for all soils, it is not possible to give a name to each combination of sizes of soil grains, so that such a term as sandy loam may be used to describe a considerable variety of actual soils. For irrigation purposes a single unit is more desirable which will more nearly express the moisture properties of the soil than the mechanical analysis. The moisture equivalent has been used for this purpose.

There are two points at which the moisture present in a soil is most important. One is the extent to which the soils should be permitted to become dry, or the moisture content at the time when irrigaton should be applied. The

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other is the maximum field capacity for moisture or the amount of water which a soil can retain within reach of the crop roots after the distribution of moisture in a soil following irrigation has taken place. The difference represents the water available for crop use and measures the maximum amount desirable to use in a single irrigation. The depth of each irrigation applied should be limited to the amount which can be stored in the soil within reach of the crops plus a certain amount to cover surface waste and some excess to allow for uneven distribution on the fields. Under some methods surface waste can be eliminated. It is difficult to apply water in practice uniformly over the whole surface. If it is desired to apply a certain average amount some excess should be used in order that all parts of the field will at least receive nearly the average desired depths. There will usually be larger amounts applied near the point where water is delivered to the fields due to excess absorption. If the surface of the land is uneven the depressions will receive excess water. The aim in choosing the method to be used and in preparing the land should be to enable as uniform a distribution to be secured as possible.

If too small depths of irrigation are used the loss by surface evaporation becomes excessive. If too large amounts are applied deep percolation occurs, unless prevented by impervious soil strata when waterlogging may result. The method of irrigation should be adapted to the soil so that the quantity required at each irrigation can be applied uniformly with a minimum of labor.

The rate at which different types of soils will absorb water varies widely. On the sandiest soils maximum rates of 12 feet per 24 hours have been observed. Rates of absorption of 8 feet in depth per day on very sandy soil and 5 feet per day on light sandy loam are representative of the maximum amounts to be expected. On very heavy clay soils the rate may be as low as 2 inches per day.

A velocity of 60 feet per minute in the travel of water across land represents about the maximum rate used. A velocity of 30 feet per minute is as high as is desirable. Velocities as low as 2 or 3 feet per minute often occur; 10 feet per minute, or an hour for a 660-foot run, represents about average practice.

The length of run and velocity of water over the land should be adjusted so as to reduce the time required and thus reduce the excess absorption at the upper side of the run. The excessive absorption which will occur near the upper end of checks can be partially equalized by making the farther ends somewhat lower, so that ponding of the water there will be greater.

*Adaptation of methods to soils.*—Free flooding can be adapted to almost any soil condition, and this flexibility is the reason for its present extensive use. On heavy soils, where water must be allowed to cover the land for several hours, small heads can be used. If the soil is sandy, requiring a quick flushing of the water over the surface, larger heads taken from closely spaced field ditches are needed. On heavy soils the field ditches may be spaced 150 feet apart; in some cases longer distances are used. On very porous soil the ditches may be spaced as close as 50 feet; 75 feet is more usual on light soils. On heavy soils long runs with heads of about 1 second-foot at each turnout, or short runs using as low as one-fourth second-foot, may be used. On light soils as large heads as can be used without soil washing give the best results. These will vary from 1 to 5 second-feet.

The border method is used on all types of soil where the other conditions are favorable. The size of head is adjusted to the soil in the same way as in free flooding. The lengths of run vary from 330 to 1,320, and the heads used from 1 to 8 second-feet per check. The widths of the checks is made

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narrower, 30 to 50 feet being typical, on either very light or very heavy soils, with widths of 60 to 100 feet on medium lands having both a fairly rapid rate of absorption and good resistance to washing.

Level checks, either square or contour, can be used to pond water on heavy soils in order to secure sufficient absorption or on very light soils in order to prevent washing. On light soils the checks should be smaller to reduce the time required to fill them and thus lessen percolation at the point of delivery. Square or contour checks can be given a slight fall away from the point of delivery in order to reduce these percolation losses and increase the depth of ponding on the sides covered last.

In the basin method the size of the check is sufficiently small, so that it is not varied with the character of the soil. The basin method is more used on orchards in either light or heavy soils than on medium types. On the light soil there is less loss in the field ditches carrying water to the basins than in furrows. In heavy soils the water can be ponded in the basins and greater absorption secured than in furrows. On medium soil types the furrow method will give satisfactory results and is more generally used.

Furrows are used on all types of soil and crop. In soil having a tendency to bake after being wet, furrows or corrugations are often used to avoid wetting as much of the surface soil as possible. In cultivated crops they are generally used. For potatoes the conditions of growth require the use of furrow methods on all soils. On heavy soils water can be left running longer in the furrows than it can in flooding without injury from scalding. In some very light soils it is necessary to use small heads in furrows in order to prevent washing. This is usually the result of both light soil and steep slope and more due to the slope than the soil.

On heavy soils furrows may be run 1,320 feet, although 660 is preferable. On the lightest soils they should not exceed 150 feet. The more usual practice on medium soils is not to exceed 660 feet.

In the surface-pipe method the water is conveyed to the point of use so that the type of soil is not as important. This method would be of greatest saving on light soils as a more uniform distribution can be secured.

*Depth to ground water.*—The depth to ground water often controls the method of irrigation used. Where the water table is within reach of the plant roots the purpose of irrigation becomes changed. On heavy soils, particularly if alkali salts are present, it may be necessary to irrigate the surface for crops which can not be cultivated in order to soften the upper soil crust and permit aeration to take place. In such cases care should be used to apply only small amounts of water in order that the water table may not be raised even higher. If the water table is permanently high, the plant roots reaching into the ground water will probably be killed. The plants then secure water from below only by the capillary rise from the water table into the area of living plant roots. If this rate of use of capillary water is not sufficiently rapid to supply the plant needs, irrigation will be needed for the upper soil. In some cases the irrigation practice must be subordinated to the prevention of further rise of the ground water until drainage can be provided.

On light soil, particularly very sandy or gravelly soils relatively free from alkali, the rise of the ground water, if it can be controlled, is sometimes beneficial. This produces a form of subirrigation generally spoken of as "subbing" the land. On such soils if no ground water or impervious layers are encountered for considerable depths, frequent irrigations are required due to the low moisture holding capacity of the soil. This requires the use of a large amount of both water and labor. If the "sub" can be brought within reach of the

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plants during the crop season this cost of surface application may be avoided. This is done in a few localities and where proper conditions are found is a very successful practice. It is only in limited localities, however, that the proper conditions exist. "Subbing" one locality often means too high ground water in adjacent lower areas. If alkali is present in the soil subbing will cause its concentration at the surface. In areas where such subirrigation is used the general practice is to irrigate heavily during the early season until the water table is brought to the desired point, then to apply only sufficient water to maintain it at this elevation. The filling of the subsoil may be accomplished by irrigating the whole field surface, by absorption from the field ditches alone, or by using only special areas, such as canal borrow pits, from which adjoining areas of soil can be filled. Certain portions of the north side unit of the Minidoka project in Idaho are "subbed," the height being largely controlled to suit crop needs during the different parts of the season.

The damage often resulting on soils of all kinds, but more particularly on the heavier types from the rise of ground water and surface accumulation of alkali, emphasizes the need of using methods of irrigation which will prevent or materially reduce deep percolation losses previously discussed.

### TOPOGRAPHY.

Free flooding and furrows are adapted to a wider range of topography than any other methods. In free-flooding methods the field ditches can be located so as to command the various higher portions and the size of stream used adjusted so as to prevent washing. With slopes of 2 inches per 100 feet or less free flooding is not desirable as the velocity of the flow over the ground becomes too small. A fall of from 6 to 12 inches per 100 feet gives the most desirable conditions for free flooding. On land having a slope of over 2 feet per 100 feet washing may occur on light soils unless small heads are used, and on heavy soils the water may pass so quickly over the surface that sufficient will not be absorbed.

Furrows can also be adapted to almost any slope found on agricultural land. On medium soils a fall of 2 to 6 inches per 100 feet gives sufficient velocity to carry the stream through the average length of the furrows, and also gives sufficient opportunity for absorption. By reducing the size of the stream carried in each furrow slopes as steep as 10 or even 20 feet per 100 feet can be irrigated. But little irrigated land has a slope greater than 10 feet per 100 feet. It is possible to reduce the grade in the furrow on steep slopes by running them diagonally to the main direction of fall. This is not generally considered desirable, however, as a break in any upper furrow will throw the stream into the next furrow below until generally all are broken, and a sufficient stream combined so that damage will result. Furrows running directly down the slopes can not break over into adjoining furrows. In the irrigation by furrows of orchards on steep slopes the furrows near the trees may be zigzagged around the trees. This increases the length and reduces the slopes without the disadvantages mentioned above.

Border checks are suited to lands having a uniform parallel slope of from 1 to 12 inches per 100 feet, slopes of 2 to 6 inches being preferable. The border method is most economically used on lands of even slope in one direction where entire fields can be laid out in parallel checks of relatively large length. It is not well adapted to fields of uneven topography even if the slopes come within the limits stated.

Square checks are best suited to lands whose slope does not exceed 6 inches per 100 feet. For the best use of water the size varies from about one-third

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to 2 acres, depending on the type of soil and head to be used. On checks as large as 1½ acres the amount of grading and distance the material has to be moved becomes large on slopes of over one-half foot per 100 feet. Smaller checks should be used on the steeper slopes.

For the steeper slopes or more irregular surfaces, contour checks are better suited. In these the width of the check is made small in the direction of the slope and the length increased in the direction of the contour. This gives long, irregular-shaped checks fitted to the topography which increase the inconvenience in irrigation and harvesting but reduces the cost of preparation. In general the fall from one check to the next should not exceed 1 foot for checks 75 feet wide, which may be taken as the minimum width desirable. This limits the method to slopes of 1 foot in 75 or 70 feet per mile. On very steep slopes this method would become more typical of side-hill terracing, which has not been used in this country as yet.

The basin method is used mainly in orchards to form temporary checks of small areas around the trees or small groups of trees, as these basins vary from 30 by 30 feet to perhaps 90 by 90 on flatter slopes. The land is not leveled within the basins.

The surface-pipe method is suited to nearly all types of topography. Its high labor cost prevents its more general use.

### WATER SUPPLY.

In some localities the only available water supplies consist of more or less irregular flood or spring flows. In order to use such supplies when available methods are required by which large amounts of water can be applied quickly. Rapidity in use is more important than economy in use. For such water supplies large ditches serving large checks are a common practice. Heavy irrigations equaling or exceeding the moisture-storing capacity of the soil can be given with a small amount of labor and in a short time. The greater irregularity of such water supplies may not warrant expensive methods of preparation of the lands. Native grass for pastures or for hay are more usually grown under such conditions.

Border checks require a relatively large head for efficient irrigation. The maximum used is 15 to 20 second-feet, as on the Modesto and Turlock systems in California. The best results are secured with heads of over 5 second-feet except for small borders on relatively heavy soils.

Square or contour checks are more adjustable in regard to the size of head received. By varying the size of checks and filling only one at a time, small heads can be used with good water economy. For ordinary square or contour checks, heads of 5 second-feet can be handled. With well-planned fields having large ditches one man may be able to handle more than this amount. It is not generally desirable to use less than 2 second-feet in any single check, and heads of over 5 second-feet, if delivered as a whole into one check, may cause washing of the soil and injury to the crop near the delivery gate. With basin checks the field ditches are smaller, and one man can not generally handle as much water as under other check methods. From 1½ to 3 second-feet represent good basin-method practice.

In free flooding more labor in guiding the water is required, as the land has not been prepared so that the flow is as completely controlled. For this reason one irrigator can not handle as much water. From 1½ to 3 or 4 second-feet represents the usual limits. On steep slopes or broken topography heads of 1 second-foot may be as large as can be handled effectively.

In furrow irrigation the efficiency of the use of the water alone is not affected by the size of head received, as the number of furrows being run can be ad-

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justed to the water supply available. The labor cost is, of course, greater for the smaller heads. One man may attend to over 100 furrows where the water is left in each furrow for several hours and the distribution to each furrow is under control. On short runs where the water is delivered to the furrows through cuts in the ditch banks one man may not be able to handle over 20 furrows. For potatoes using perhaps one-twentieth of a second-foot in each row this gives heads of from 1 to 5 second-feet. For orchards or smaller furrows the heads may vary from less than 1 second-foot to 2 second-feet. In some sections of California heads as small as one-fifth second-foot are used continuously on steep lands in orchards. In corrugation of field crops heads of from 1 to 3 second-feet represent the usual practice.

In surface-pipe flooding only small heads can be used. The necessity of moving the pipe in the field limits its size to 8 or 10 inches in diameter, which with the usual slope and pressure available give heads of 1 to 2 second-feet.

### OTHER FACTORS.

The kind of crops to be grown influence the choice of the method of applying water to soils in several ways. The most important of these is the general classification of crops into those covering the whole field surface and those only covering a portion of the area or as more usually expressed the division between crops which can be cultivated and those which can not. Crops grown in rows are usually cultivated and the spaces between the plant rows utilized for the application of water. The furrow methods are naturally adapted to such practice.

The value of the crop to be produced also influences the preparation of the land. For crops of relatively large financial returns much more expense can be incurred both for the water itself and for methods of using the water which will reduce the amount required. Methods highly economical in the citrus orchards of southern California might be equally highly wasteful financially for grain. The value of the land is also a factor, although this more usually is the result of the value of the crop.

The number of irrigations required for different crops also should be considered. The object of better methods of preparing land and applying water is to save both in the quantity of water used and the labor required in its application. This saving is often proportional to the number of irrigations required and warrants the use of much better methods on alfalfa which may be irrigated from three to six times per season than on grain which may ony be irrigated one or two times.

The climate affects all agricultural practice, including irrigation. Its most important effect on irrigation is the influence which climate exerts on the kind and value of the crops which can be raised. The effects on irrigation practice of the different crops has already been discussed. The length of the growing season determines the number of irrigations for the forage crops which produce throughout the frost-free period. The seasonal distribution and amount of the rainfall are also important.

The type of farmer has an important influence on irrigation practice, or, more correctly, on changes in irrigation practice. Where a community becomes established under one type of agricultural conditions which may result in a certain type of irrigation practice it is difficult to change the general agricultural and irrigation methods without also changing the farmers. It has been easier to secure the adoption of newer methods among new settlers on new land than to change the methods on the older areas. This is, of course, due also to the fact that on new land the settler is more free in his selection of methods than

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on a developed farm, where a change involves the loss of some previous work. This condition is also relatively temporary, as the methods on the older areas must be changed to meet the competition of production cost on the newer ones, either by present owners themselves or by their successors.

### CONCLUSIONS.

There are seven principal methods of irrigation used in the United States: Free flooding, border or strip checks, square checks, contour checks, basins, furrows or corrugations, and surface pipe. Each of these methods is best adapted to certain conditions, but no one method is adapted to all conditions.

The character of the soil is the most important element in the choice of the method of irrigation. The moisture capacity determines the amount which can be used at each irrigation without causing losses from deep percolation. The rate of absorption determines whether the water should be quickly flushed over the surface in order to give more even distribution or whether small amounts should be allowed to flow for longer times in order that enough may be absorbed.

Free flooding methods can be more easily adapted to varying soil conditions than other methods by varying the spacing of the ditches and size of head used. Border checks are adapted to all soils where other conditions are suitable. Square checks are suited to soils which are heavy, so that the water needs to be ponded on them, or for soils so light that washing will occur if sloped.

Furrows can be adjusted to all types of soil. For light soils short runs are used, giving each furrow all the water which it can carry without washing. For heavy soils small amounts are used for longer times.

The depth to ground water does not affect the method of irrigation until the water table rises within reach of the plant roots. In such case the depth to water becomes the controlling factor. On light soils a water table within reach of the plants is often beneficial; on heavy soils it is usually injurious.

The topography influences the method of irrigation to be used more than any other factor except soils. Free flooding and furrows are more easily adapted to different slopes and roughness of land. Water can be carried to the higher parts and the size of head adjusted to the slope.

The various check methods are more limited in the slopes to which they are adapted. On steep slopes either the size of the checks has to be greatly reduced or the extent of the leveling required is excessive. The surface pipe method is particularly suited to uneven land as the water is carried in the pipes to each place of application.

The character of water supply may control the method. Supplies available for limited periods of time require methods adapted to quick applications. Small water supplies require small checks and short runs. Expensive methods of preparing land are not warranted where the water supply is uncertain. Border checks are best suited to large heads; furrow methods can be adapted to small heads.

The kind of crop may determine the method of application. Furrows are generally used for cultivated or row crops. The value of the crop determines the expense warranted in its production including its irrigation.

The length of crop season is a factor. For crops given only one or two irrigations the loss from excessive irrigation on poorly prepared land is not as great as where several irrigations are required. The distribution and amount of the rainfall may affect the time and number of irrigations also.

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The type of farmer has a strong influence on changes in methods of irrigation. It is easier to secure the adoption of better methods on new lands than to change the methods of older farmers.

All of these factors should be considered in selecting the method of irrigation to be used on a given farm. It is seldom that the same method is adapted to all of any farm, and a complete farm plan is required if the methods to be used are to be correctly chosen and efficiently installed.

BULLETINS AND PAMPHLETS.

R. P. Teele. Preparing Land for Irrigation. Reprint from Yearbook of U. S. Dept. of Agric. for 1908.

S. Fortier. Methods of Applying Water to Crops. Reprint from Yearbook of U. S. Dept. Agric. for 1909.

E. Mead. Preparing Land for Irrigation and Methods of Applying Water. 1904. Bull. 145, Office Experiment Stations, U. S. Dept. Agric.

S. Fortier. Practical Information for Beginner in Irrigation. 1906. Farmer's Bull. 263, U. S. Dept. Agric.

H. B. Bonebright. Irrigation Practice in Montana. 1913. Circular 29. Montana Agric. Exper. Station.

S. Fortier. Irrigation of Alfalfa. Farmer's Bull. 378, U. S. Dept. Agric.

F. W. Roeding. Irrigation of Sugar Beets. Farmer's Bull. 392, U. S. Dept. Agric.

W. W. McLaughlin. Irrigation of Grain. Farmer's Bull. 394, U. S. Dept. Agric.

S. Fortier. Irrigation of Orchards. Farmer's Bull. 404, U. S. Dept. Agric.

BOOKS.

Irrigation Practice and Engineering. B. A. Etcheverry. Vol. I. Use of Irrigation Water. 1915.

Use of Water in Irrigation. S. Fortier. 1914.

Principles of Irrigation Practice. J. A. Widtsoe. 1914.

## Adjournment.

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## JOINT SESSION OF SUBSECTION 3 OF SECTION III AND SUBSECTION 3 OF SECTION V.

RALEIGH HOTEL,
*Wednesday afternoon, December 29, 1915.*

Chairman, JOHN B. WHITEHEAD.

The meeting was called to order at 2.30 o'clock by the chairman.

Papers presented:

Aerial transporters in the port sheds of Montevideo, by Eduardo García de Zúñiga.[1]

The white coal of Brazil and its uses, by Luiz Betim Paes Leme.

Hydroelectric utilization at Niagara and elsewhere, by Maurice Deutsch.

The CHAIRMAN. The first paper is on "The white coal of Brazil and its uses." The author is Senhor Luiz Betim Paes Leme, delegate from the engineers' club of Brazil, and a member of the National Museum. I now call upon Senhor Paes Leme.

### MEMOIRE SUR LA HOUILLE BLANCHE AU BRÉSIL ET SES APPLICATIONS.

Par LUIZ BETIM PAES LEME,
*Director da Companhia Sul Bahiana de Combustiveis.*

Ce fut seulement vers la fin du mois d'octobre que le comité organisateur du Congrès Scientifique Pan-American priât par télégramme l'Honorable Sir Edwin Morgan d'obtenir qu'un mémoire sur la houille blanche au Brésil fut écrit spécialement pour le Congrès, par un des membres de la représentation de ce pays.

L'invitation m'a donc été faite par Sir Edwin Morgan, et c'est la seule excuse que j'aie d'avoir accepté l'honneur d'être chargé d'une si ingrate besogne.

Ceux qui connaissent l'illustre Ambassadeur des Etats-Unis au Brésil me comprendront. Pour ma part, je n'ai jamais eu l'occasion d'apprécier, même chez les diplomates du Vieux Monde, un assemblage aussi parfait de culture intellectuelle et d'élégance mondaine. Comblé de politesses, séduit par son esprit et par son charme personnels, il est évident qu'aucun des amis de Sir Edwin Morgan n'aurait songé un seul instant à refuser une invitation faite par son intermédiaire.

[1] Paper printed in Volume VI of the Proceedings of the Second Pan American Scientific Congress.



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Résumons les difficultés presque insurmontables que présente notre sujet: l'étude complète d'une chute d'eau ne peut se faire que dans une période de quelques années. Il faut mesurer le débit d'une rivière journellement pendant cette période. Il faut en outre avoir la topographie des régions en amont de la chute pour connaître l'importance des barrages et des réserves d'eau que l'on peut y établir.

Toutes ces opérations nécessitent des dépenses considérables, et n'ont été faites au Brésil que sur quelques chutes déjà aménagées. Et même sur des chutes déjà aménagées, il est très difficile d'obtenir des données précises.

J'ai distribué cependant près de 200 circulaires au Gouvernement des Etats et aux compagnies particulières. Vous trouverez ci-joint les modèles de ces circulaires. Le nombre de réponses que je reçus fut très restreint. La plupart ne contenait que des données tout-à-fait imprécises.

Les mesures de débit, pour la presque totalité des chutes au Brésil n'ont été faites qu'à l'aide de flotteurs (méthode très défectueuse), et cela une seule fois, à une date vague qui peut aussi bien correspondre à une période de crue qu'à une période d'étiage.

De sorte que, dans son ensemble, on ne possède au sujet des innombrables chutes d'eau brésiliennes que des renseignements sans aucune valeur scientifique. On nous signale partout des chutes de grande hauteur, ou avec des volumes gigantesques, mais les indications données sur la puissance utile me semblent tout-à-fait fantaisistes et ne doivent être reproduites que sous toutes réserves.

Il est hors de doute, cependant, que l'on trouve au Brésil des forces hydrauliques d'une importance exceptionnelle, et l'étude de celles qui ont déjà été aménagées nous fournit un certain nombre de renseignements intéressants.

Nous diviserons cette étude en trois parties: Distribution géographique des chutes; Régime des eaux; Utilisation de l'énergie.

### Première Partie—Distribution géographique des chutes.

Il suffit de jeter les yeux sur une carte du Brésil où se trouvent indiquées les altitudes des diverses régions pour se rendre compte de la répartition des forces hydrauliques. A l'extrême nord, dans l'énorme bassin de l'Amazone, les fleuves sont presque tous navigables. Ils rendent peut-être de ce chef des services plus grands que s'ils avaient été coupés par des chutes. Cependant, à de grandes distances de leur embouchure, on entre dans la région des rapides.

Je pense que des forces considérables peuvent être captées sur ces rapides. Ces fleuves qui, même en étiage, permettent la navigation à des bateaux de haut tonnage, présentent dans cette région des dénivellements de plusieurs mètres sur un kilomètre ou deux de parcours. Aucune étude de cette question n'a été faite jusqu'à ce jour. Ces forces ne trouveraient d'ailleurs aucune application dans l'état actuel de la région.

Le Colonel Rondon, seul et en compagnie du Président Roosevelt, a traversé en amont un plateau élevé sur lequel se trouve la ligne de partage des eaux, entre la vallée de la Plata et la vallée de l'Amazone, et ce vaillant explorateur a décrit plusieurs chutes de 80 mètres de hauteur, situées au bord de ce plateau. On peut trouver la description de ces chutes dans les rapports officiels presentés au sujet de la pose des lignes télégraphiques qui traversent la région inhabitée du Brésil.

Le Colonel Rondon estime la puissance de ces chutes à plusieurs centaines de mille chevaux. Cette estimation n'est cependant basée que sur une mesure unique, faite par des méthodes tout-à-fait rudimentaires.

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Le récent ouvrage du Baron Homem de Mello signale dans les différents fleuves du bassin de l'Amazone, un nombre considérable de chutes (à peu près 80), parmi lesquelles la chute de Taquatinga (Goyaz), sur le fleuve Dois Irmaos, avec 66 mètres de hauteur; celles de Façâo et Catadupa, avec 33 et 66 mètres de hauteur, sur le Rio das Almas, affluent du Tocantins, et celle de Rio Preto, affluent du Rio Maranho, avec 76 mètres de hauteur. Pour la plupart des quatre-vingts autres, cet auteur cite leur nom et leur emplacement, sans fixer la hauteur de chute ni le volume d'eau.

En dehors du bassin de l'Amazone, les états de l'extrême nord brésilien ne possèdent pas de chutes importantes. On connaît à peine une chute de 75 mètres sur l'Oyapock.

Les Etats de Maranhao, de Ceara, de Rio Grande do Norte, Parahyba et Pernambuco sont pauvres en houille blanche. On signale pourtant a Pernambuco quelques chutes de faible puissance.

Nous arrivons alors sur le bassin de São Francisco, un des fleuves les plus importants du Brésil. Il a 3,000 kilomètres de parcours et draine une surface de 668,500 kilogrammes carrés.

Sur ce fleuve, on trouve la très importante chute de Paulo Affonso. C'est dans la région de cette chute que le fleuve São Francisco traverse la cordillière qu'on appelle la Serra do Mar. Des études récentes effectuées sur cette chute, au cours du plus fort étiage observé jusqu'à ce jour, ont fixé a 400,000 HP. la puissance minimum.

La hauteur utilisable est de 80 mètres.

La variation de débit du fleuve entre l'étiage et la période des pluies est considérable. On a mesuré en aval de la chute une différence de niveau de 27 mètres entre ces deux périodes.

Je pense que la construction d'un certain nombre de barrages en amont de la chute pourrait atténuer cet inconvénient, tout en augmentant considérablement la puissance moyenne utilisable. La construction des grands barrages n'est pas très chère au Brésil, où le granit abonde, où les fondations sont en général faciles, et où le terrain à noyer ne coûte presque rien dans la plupart des cas.

En amont de la chute de Paulo Affonso, on trouve encore sur le São Francisco et sur ses affluents de nombreuses sources d'énergies.

Dans l'ouvrage du Baron Homem de Mello, ainsi que dans un ouvrage spécial sur les chutes d'eau de Minas Geraes, publié par Monsieur Nelson de Senna, on peut trouver une longue liste de noms accompagnés de photographies, mais où les chiffres manquent totalement. Signalons cependant le fleuve Paracatú, affluent du São Francisco, qui traverse une région très accidentée. avec un fort volume d'eau et présente le long de son cours vingtaine de chutes déjà connues et signalées dans divers ouvrages, quoique sans aucune indication précise sur la puissance disponible.

Signalons en outre les nombreuses, mais malheureusement peu importantes chutes du Rio Paraopeba et du Rio das Velhas, affluents du São Francisco, qui se trouvent dans une importante région très peuplée et où abondent les minerais d'or et de fer. Ces rivières, dûment, régularisées par des barrages, pourraient peut-être fournir une centaine de mille chevaux.

On trouve dans ce bassin les installations électriques pour la ville de Bello Horizonte, ainsi que les installations de la São João del Rey Gold Mining Company, importante mine d'or dont les galeries sont déjà à une profondeur de 1,800 mètres.

A Bahia, nous avons des renseignements précis sur deux chutes sur le fleuve Paraguassú. L'une d'elles peut-être considérée comme déjà aménagée par la

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maison Guinle & Cie, pour les besoins de la ville de Bahia, et l'autre, appartenant à la même firme, est encore en réserve pour les besoins futurs.

La chute dont les travaux d'aménagement sont presque terminés s'appelle Bananeiras. La ligne de transmission de force jusqu'à Bahia a 102 kilomètres de longueur; les turbines installées ont une force de 20,000 H P., et la hauteur de chute est de 40 mètres. Le barrage, construit avec 18 mètres de hauteur, peut emmagasiner 150 millions de mètres cubes. La chute de reserve s'appelle Tymbara, se trouve à 95 kilomètres de São Felix et a encore 40 mètres de hauteur, avec un débit de 50 mètres cubes par seconde, mesuré pendant l'étiage de 1909.

Au Sud de Bahia, sur le Jequitinhonha, sur le Pardo et dans la région du Rio de Contas, il existe des chutes d'une très grande importance qui n'ont jamais été signalées dans des publications. Leur proximité de la mer et l'existence de nombreuses rades abritées dans ces parages les rendent fort intéressantes.

Je regrette de ne pouvoir donner aucun chiffre sur la puissance de ces chutes, mais nous nous trouvons en présence de fleuves qui drainent des bassins de plus de 50,000 kilomètres carrés chacun, et qui tombent de 1,000 mètres de hauteur en moins de 200 kilomètres de parcours, avec des parties navigables intercalées dans des parties fort accidentées.

En dehors même du bassin de ces fleuves, dans la région de Marahu où l'on procède en ce moment à des recherches de pétrole, on trouve tout au bord de la mer plusieurs chutes d'une dizaine de mille chevaux.

En passant à l'Etat de Espirito Santo, nous trouvons le Rio Doce, qui a sa source à l'Etat de Minas Geraes. C'est par la vallée de ce fleuve, dans laquelle se trouve déjà le chemin de fer Victoria Minas, qu'un puissant syndicat anglais comptait, en électrisant ce chemin de fer, transporter annuellement 10 millions de tonnes de minerai de fer. Ce projet, qui se réalisera sûrement un jour ou l'autre, est basé sur l'existence de très importantes chutes d'eau sur cette rivière, qui draine une surface de 97,500 kilomètres carrés, et qui présente des chutes abruptes de 80 mètres de hauteur, au droit desquelles le fleuve se trouve étroitement encaissé dans un lit de pierre.

La chute de Antonio Dias, qui se trouve à peine à 150 kilomètres de la capitale de Minas Geraes, et toute une série d'autres chutes à la frontière de l'Etat de Espirito Santo, peuvent donner une force de plusieurs centaines de mille chevaux.

La vallée du Rio Doce est très riche en minerais de fer et en minerais d'or.

L'Etat de Espirito Santo, qui est un des plus accidentés du Brésil, possède de nombreuses chutes sur les fleuves Itabapoana, Itapemirim, et sur d'autres de moindre importance.

L'Etat de Rio de Janeiro est un des plus riches en houille blanche. Rien que le fleuve Parahyba de Sul, qui draine 64,000 kilomètres carrés, et qui présente tout le long de son cours et tout le long du cours de ses affluents, de très nombreuses chutes, peut fournir au bas mot une force de plus d'un million de chevaux. Les barrages sont très faciles à construire, surtout sur les affluents.

Un des affluents du Parahyba, le Pirahy, a été dévié par la Rio de Janeiro Tramway Light and Power Company, Limited, au moyen d'un tunnel de 9 kilomètres, et jeté dans la vallée du Ribeirão das Lages, où cette compagnie avait déjà un grand lac artificiel de 250 millions de mètres cubes, et une chute de 360 mètres de hauteur.

Voici les données de cette importante installation:

Force déjà aménagée: 55,000 kilowatts; force encore disponible sur cette chute: 22,000 HP.

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La ligne de transmission de force jusqu'à Rio a 81 kilomètres et la difference de potentiel est de 88,000 volts.

Sur un des affluents du Parahyba, le Piabanha, se trouvent les installations de la maison Guinle et Cie., pour la ville de Nictheroy. On y trouve 9,000 kilowatts déjà installés et cette firme possède sur la même fleuve des chutes de réserve capables de fournir encore 25,000 HP.

Un autre affluent très important du Parahyba est le Parahybuna, que présente de très nombreuses chutes à pic d'un aménagement très facile et pouvant développer une puissance que j'évalue à plus de 100,000 HP. pour l'ensemble des chutes de cette rivière. C'est là que se trouvent les installations de force et de lumière pour la ville de Juiz de Fora à Minas Geraes.

Au sud de la ville de Rio, on trouve toute une série de chutes caractérisées par une très grande hauteur et un faible débit. La plus intéressante est la chute de Bracuhy, que j'ai étudié moi-même. Sa hauteur utile est de 880 mètres, et son débit moyen est de 8 mètres cubes par seconde, débit dont on peut s'assurer en construisant deux barrages déjà complètement étudiés, en amont de la chute. Cette chute est à 8 kilomètres du bord de la mer, dans une rade abritée.

Dans cette région, on trouve plusieurs autres chutes, parmi lesquelles on peut citer Ariro, Mambucaba, toutes au bord de la mer.

La chaine de montagne d'où tombent tous ces petits cours d'eau se prolonge jusqu'à l'Etat de Santa Catharina, en longeant tout l'Etat de Paraná et tout l'Etat de São Paulo. Ceci représente une extension de 880 kilomètres de côte brésilienne où l'on trouve des altitudes de 1,000 mètres de hauteur a moins de 20 kilomètres de la mer. On y rencontre donc à chaque pas des torrents de plus ou moins grande importance, et souvent au moyen de tunnels, ou même de simples siphons, on peut imiter la Light and Power de Rio de Janeiro et dévier les eaux des plateaux supérieurs qui coulent vers l'intérieur, pour les jeter directement à la mer en suivant des torrents abrupts de plusieurs centaines de mètres de hauteur. Cette solution s'impose pour les eaux du Tetre, au nord de Santos.

Près de Santos, se trouve la chute de Itapanhaú, de la Compagnie Docks de Santos, avec 650 mètres de hauteur, et 4 mètres cubes de débit. Plus au sud il y a des chutes qui appartiennent à la São Paulo Railway, et qui furent acquises dans le but d'électrifier ce chemin de fer. Je n'ai pas de données sur ces chutes. Je n'ai pas non plus de renseignements sur les chutes qui existent entre Santos et la Ribeira de Iguape. Là on trouve encore une rivière à gros débit, et à très forte pente. Le bassin qui l'alimente a 28,900 kilomètres carrés de surface. Je ne connais pas de résultats de mesure sur les chutes existant sur cette rivière; elle se trouve dans une zone très fertile, riche en minerais, mais très peu habitée. On vient cependant d'y inaugurer une colonie japonaise.

En suivant toujours la ligne de la côte, nous trouvons à Paraná des chutes bien inférieures à celles qui se trouvent sur la côte de Rio de Janeiro et de São Paulo. Parmi elles, on peut citer celle qui fournit la lumière et la force à Paranagua.

A Santa Catharina, extrémité sud de la Cordillère, qui longe la côte, la chute principale est, d'après les publications existantes, la chute du Pilão, sur le fleuve Itajahy, avec 524 mètres de hauteur.

A l'Etat de Rio Grande do Sul, sur les fleuves qui débouchent dans l'Atlantique, on cite plusieurs chutes sur le Rio Jacuhy, mais leur importance doit être faible. J'ai cependant entendu parler d'une chute assez importante à l'extrême sud, sur un affluent du San Gonçalo.

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Passons maintenant aux bassins intérieurs, ceux qui alimentent des rivières qui coulent vers les grands sillons tracés par les rios Paraná et Paraguay, dont la jonction produit le rio de la Plata.

On trouve dans les publications spéciales de Monsieur Nelson de Senna et du Major Nascimento une énumération qui paraît très complète des chutes de ces bassins, dans l'Etat de Minas Geraes, et dans l'Etat de Paraná.

Monsieur Senna donne les noms de 1,160 chutes dans l'Etat de Minas. Il en cite trop, car dans sa liste on en trouve dont l'importance est vraiment trop minime.

Le Major Nascimento en cite 119 dans l'Etat de Paraná. Aucun travail de ce genre n'a été publié, ni pour São Paulo, ni pour Rio de Janeiro, mais nous savons qu'on en prépare un à São Paulo.

J'ai déjà énuméré les principales chutes de l'Etat de Rio de Janeiro et du littoral de l'Etat de São Paulo et de l'Etat de Paraná, et je vais maintenant signaler les principales chutes des bassins intérieurs de ces états, en passant sous silence les très nombreuses chutes de faible importance.

Elles se trouvent toutes mentionées dans les ouvrages que je viens de citer, quoique sans indication précise sur la puissance.

A Minas Geraes, en dehors des chutes déjà citées qui se trouvent sur les bassins du São Francisco et du Parahyba do Sul, on en trouve d'excellentes dans les deux très importants bassins du Paranahyba et du Rio Grande.

Ces deux rivières, dont la jonction forme le fleuve Paraná, contiennent plusieurs chutes. Une seule de ces chutes, qui a été recemment étudiée et qui se trouve près de São Paulo dans une région où se développe l'élevage et où il y a déjà un abattoir frigorifique, la chute de Marimbondo, paraît être extrêmement puissante. On m'a fourni le chiffre d'un million de chevaux, mais je ne le reproduis que sous toutes reserves. Il me paraît très exagéré.

Dans l'Etat de São Paulo, on trouve deux bassins très riches en houille blanche: le bassin de Tiété, où se trouvent les installations de la Light and Power de São Paulo, et le bassin de Paraná-panema.

Les nouvelles installations de la Light and Power ont porté la force aménagée par cette compagnie à 40,000 HP. De plus, il existe dans l'état diverses installations pour des petites villes. Les plus importantes sont celles de Ribirão-Preto, de Piracicaba, et celle du nord de São Paulo. L'Etat de São Paulo possède plus de 80 villes ayant déjà la lumière électrique et des installations sanitaires.

Les principales chutes du bassin du Tiété sont: la Avanhandava, avec 60,000 HP., et celle d'Itapura, avec peut-être 50,000 HP.

Dans l'Etat de Paraná, qui est certainement un des plus riches en forces naturelles, on trouve deux des plus importantes chutes du monde entier: celle de l'Iguassu et celle de Sete Quedas. Sur ces deux chutes on cite des chiffres fantastiques. Ainsi, je trouve pour l'Iguassu, dans deux ouvrages différents, les chiffres de 14 et 25 millions de chevaux. Des études récentes, qui me furent confiées par un propriétaire de la région, évaluent la puissance de la chute simplement à un million de chevaux, puissance mesurée pendant un étiage rigoureux. Ce chiffre me paraît bon, eu égard à l'importance du bassin. La chute a 65 mètres de hauteur à pic.

Pour la chute de Sete Quedas on cite, dans deux ouvrages différents, les chiffres de 25 et 40 millions de chevaux. Ces chiffres ne me paraissent pas exagérés puisque le bassin du Paraná est cinquante fois plus grand que le bassin de l'Iguassu, et que l'on peut créer une chute de 115 mètres de hauteur entre la première et la dernière des Sete Quedas. Il semble donc que sur ce point du territoire brésilien, on se trouve en présence d'une des plus importantes, sinon de la plus importante, des chutes d'eau du monde.

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En amont de cette chute, on en trouve d'autres sur le fleuve Paraná. La plus importante semble être la chute de Urubú-Pungá.

Toutes ces chutes du bassin de la Plata, à grand volume d'eau, présentent un inconvénient très serieux. Au moment des crues le niveau d'eau s'élève considérablement en aval de la chute. Pour l'Urubú-Pungá, la chute arrive à disparaître, les eaux, en amont et en aval, prenant le même niveau.

Nous avons déjà dit qu'à la chute de Paulo Affonso, Rio São Francisco, on observe couramment des crues qui relèvent les eaux, en aval de la chute, d'une hauteur de 27 mètres. On peut cependant, en prolongeant le canal de fuite, ou en construisant des barrages en amont, diminuer et même supprimer cet inconvénient. Il se traduit cependant toujours par un accroissement de la dépense de première installation.

Pour terminer cette partie de notre travail sur la distribution géographique des chutes au Brésil, il nous reste à parler des Etats de Mato Grosso et de Goyaz. Ces deux Etats sont fort peu connus. Ils ont à eux deux une surface supérieure à celle du Mexique, et des fleuves importants les traversent.

A Goyaz, d'après le relief du sol, je soupçonne l'existence de nombreuses chutes sur les affluents de la rivière Paranahyba.

Quant à Matto Grosso, en dehors des chutes du Paraná, déjà citées, qui se trouvent aux frontières de cet état, et de celles découvertes par le Colonel Rondon et situées au bord du plateau des Pérecis, avec quelques centaines de mille chevaux, je ne connais pas d'autres chutes qui vaillent la peine d'être citées. Cet important état a une surface relativement plane.

## Deuxième Partie.—*Régime des eaux.*

Abordons maintenant la question du régime des eaux.

Dans les pays froids, les glaces constituent des réservoirs naturels qui rendent le débit des rivières assez peu variable. Dans les pays chauds, et en particulier au Brésil, leur débit varie entre de bien plus larges limites, et l'on constate d'une saison à l'autre, et même d'une année à l'autre, des variations énormes.

Les saisons sont cependant assez régulières, et la variation des débits se produit, depuis un certain nombre d'années, toujours dans le même sens, celui de la décroissance.

Il est évident que cela ne pourra pas se produire indéfiniment, se serait la misère et la mort du pays. Nous savons que partout les périodes sèches et les périodes humides se succèdent toujours. Ce que l'on n'a pas encore pu déterminer, pour chaque pays, c'est la durée de cette période.

La découverte dans les archives d'une petite ville au bord de la mer Caspienne, d'une série d'observations sur le niveau de ce grand lac depuis l'an 1000 a permis de fixer à 11 ans la durée de chacune des périodes sèche et humide, pour les bassins qui alimentent le lac.

L'examen de certains vieux arbres de la Californie a fourni des renseignements analogues pour cette partie des Etats-Unis. On peut en effet déterminer dans un arbre de combien il a grandi chaque année, et en admettant que la hauteur dont il a grandi soit proportionnelle à la quantité de pluie tombée, on en conclut que la hauteur des pluies est périodiquement variable, puisque la courbe de croissance est une sinussoide.

Au Brésil, il n'existe pas de données qui permettent encore de déterminer l'allure de la courbe des pluies.

Des observations précises n'existent que depuis très peu de temps. Des mesures de débit périodiquement et rigoureusement faites par la Light and Power de Rio de Janeiro, et par le service des eaux et égouts de la ville de

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São Paulo permettent cependant de dire que depuis l'année 1905, les eaux ont diminué constamment. Au cours de chaque période d'étiage les eaux ont été plus basses qu'à l'étiage précèdent; chaque crue a été moindre que celle à laquelle elle a succédé. Dans certaines sources à São Paulo, le débit total de l'année 1915 a été le tiers du débit total de l'année 1909.

Le débit du fleuve Parahyba était en août 1905 de 250 mètres cubes par seconde, et en septembre 1915 à peine de 143 mètres cubes. Ces observations ont été faites par les ingénieurs de la Light and Power de Rio de Janeiro à Sapucaya.

Le débit de la rivière qui produit la force pour Rio de Janeiro tomba de 1905 à 1915 au tiers de ce qu'il était dans la plupart des mois de l'année. Grâce cependant au puissant lac artificiel créé par cette compagnie, les services n'ont pas beaucoup souffert.

Quant à la variation de la hauteur de pluie d'une région à l'autre du Brésil, on peut observer d'après les données de l'Observatoire, publiées en 1910, que la hauteur de pluie est proportionnelle à la hauteur topographique et inversement proportionnelle à la distance de la mer. Les plus fortes hauteurs de pluie furent observées en haut de la Serra do Mar, près de Santos, où la hauteur a atteint 8 mètres dans l'année. A Rio la hauteur a été de 1 mètre.

A l'extrême nord, il pleut régulièrement pendant six mois de l'année, et il fait beau pendant les autres six mois. Les habitants de ces régions appellent hiver la période des pluies, et l'été la période de beau temps, quoique ces périodes en coincident pas avec les époques ainsi dénommées astronomiquement.

Sur la plupart du territoire brésilien la hauteur de pluie a varié pour l'année 1910 de 1 à 2 mètres.

TROISIÈME PARTIE.—*Utilisation de l'énergie électrique.*

Au Brésil, comme partout ailleurs, l'énergie électrique fut tout d'abord appliquée à l'éclairage des villes, et à la traction pour services urbains. Ces applications prirent un grand essor dans les états riches, et jusques dans les petites provinces sans grandes ressources, l'éclairage au gaz fut rapidement remplacé par l'électricité. Il est même des régions où le gaz n'a jamais existé et où on ne l'installera peut-être jamais.

Ce sont là cependant des industries de luxe qui ne contribuent guère au développement et à la richesse du pays, et malheureusement depuis trop longtemps nos chutes d'eau restent strictement confinées dans ce département de l'industrie. Il n'existe, en dehors de ces applications, qu'une toute petite usine à Minas Geraes, pour la fabrication du carbure de calcium; encore cette usine n'existe que grâce à une très forte protection dauanière. Aucun chemin de fer d'intérêt général ne fut encore électrifié. Aucune industrie électro-chimique n'a encore été inaugurée, et l'on voit à peine l'électricité servir à l'éclairage et à la force motrice de quelques usines, et encore la plupart des grandes usines situées dans les villes préfèrent engendrer elles-mêmes leur force motrice avec du charbon, tant est élevé encore le prix de vente du courant par les grandes compagnies centrales.

Cet état de choses s'explique en partie par les monopoles qu'il a fallu donner aux compagnies centrales, monopoles qui se justifient par l'énorme dépense de première installation que représente un grand réseau de distribution dans les villes, et par le fait que malgré les excellentes conditions techniques des chutes brésiliennes, il a fallu cependant travailler dans des régions privées de voies de communications, et aussi installer des barrages coûteux, mettant les villes à l'abri des fâcheuses conséquences que pourraient entraîner les variations trop brusques du débit des rivières.

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Cependant, les énormes bénéfices encaissés par les compagnies centrales font penser qu'on aurait pu, avec un peu plus de rigueur administrative, arriver à un état de choses plus favorable au développement de l'industrie.

Voilà ce qu'il en est pour le passé, et même pour le présent.

Quant à l'avenir, les beaux projets ne manquent pas. La Compagnie Victoria Minas, dont nous avons déjà parlé, appuyée par un puissant syndicat anglais, projette l'électrification d'un chemin de fer de 600 kilomètres de longueur, pour le transport annuel de 10 millions de tonnes de minerai de fer par le port de Victoria.

Plusieurs projets importants qui furent passés au crible d'une étude approfondie faite par l'éminent Professeur Blondel, prévoient le transport de force par courant continu et sa transformation en courant triphasé pour les moteurs des locomotives.

Cette façon de voir se justifie par le fait que l'on trouve comme point de contact avec la terre, d'un côté la mer, et à l'autre extrémité, les mines de fer.

On prévoit aussi l'électrification du chemin de fer central du Brésil, dans la zone suburbaine qui entoure la ville de Rio et où le trafic est extrêmement intense. On a même pensé à prolonger l'électrification jusqu'en haut de la Serra do Mar, où des rampes assez fortes et de nombreux tunnels rendent très convenable ce système de traction.

D'abondantes chutes d'eau très faciles à amenager se trouvent soit dans la région du chemin de fer central, soit dans la région de Victoria Minas. Je connais encore à l'étude un projet d'électrification de la São Paulo Railway et du chemin de fer Paulista. Tous ces projets ne sont cependant pas encore entrés en voie d'exécution.

Cette question de l'électrification des chemins de fer est assez difficile à résoudre dans les pays neufs, pour la raison suivante: un des avantages de la traction électrique est de permettre un tracé comportant des rampes plus fortes que celles généralement admises pour la traction à la vapeur. Cet avantage est énorme dans les pays accidentés comme le Brésil. Cependant, comme les dépenses de première installation sont généralement beaucoup plus grandes pour un chemin de fer électrique, il est très rare qu'au moment de la construction, la ligne présente un trafic suffisant pour justifier l'électrification; de sorte que le problème de l'électrification ne vient à se poser que justement quand le lit du chemin de fer est déjà construit, et quand les énormes sacrifices consentis pour avoir de faibles rampes ne peuvent plus être évités.

Au Brésil, le charbon étranger coûte très cher. Le charbon national est de mauvaise qualité et ne se trouve que dans des régions au sud de l'Etat de São Paulo. De sorte que l'électrification des chemins de fer a beaucoup séduit les esprits.

Je me demande cependant, avec la difficulté que l'on a et que l'on aura pendant longtemps après la guerre pour se procurer des capitaux, si nous pouvons avoir grand espoir de réaliser tous ces projets si brillants, mais si coûteux.

Pour ma part, je pense que le problème du combustible pour la traction dans les chemins de fer brésiliens sera, bien avant l'électrification, résolu par le traitement des combustibles pauvres du pays, ou par une meilleure adaptation des moteurs à ces combustibles.

Le grand avenir des chutes d'eau brésiliennes est, à mon avis, dans les grandes industries chimiques et électro-métallurgiques. La fabrication des nitrates s'impose auprès des chutes de Paulo Affonso, qui se trouvent sur une rivière navigable, près de la mer, et dans une région où les roches calcaires abondent.

Je pense que l'on pourrait entreprendre aussi avec succès la fabrication de la soude dans les chutes voisines de Rio-de-Janeiro, où se trouve un marché

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très important pour cet alcali, dans les nombreuses fabriques de savon, de verre, de bougies, etc.

Le chlore, qui est partout ailleurs un sous-produit très gênant, pourrait être expedié à Minas Geraes pour traiter les minerais d'or.

Qu'il soit dit en passant, l'industrie de l'or au Brésil, où l'on a enregistré tant d'insuccès, et qui cependant fut si prospère au temps où il existait encore de riches alluvions, cette industrie ne fut délaissée que parce que l'on a commis l'erreur de penser que le procédé par cyanuration, qui a si bien réussi au Transvaal, était applicable à nos minerais. Or, il paraît aujourd'hui démontré que le chlore donnerait des résultats bien supérieurs dans notre cas.

Pour terminer, abordons la question de l'électro-métallurgie: ce problème, qui m'a toujours passionné, et auquel j'ai consacré la plus grande partie de mes efforts et de ma jeunesse, a été bien près d'être résolu au Brésil. Nous y avons des éléments tout-à-fait favorables pour le résoudre. Des chutes d'eau importantes, soit au bord de la mer, comme le Bracuhy, reliée aux mines par chemin de fer, soit au cœur même du minerai, comme la chute d'Antonio Dias, rappellent les conditions faborables de la Norvège et de la Suède.

De plus, nous avons un marché intérieur très important, et des possibilités de concurrencer l'industrie européenne dans les pays voisins, comme l'Uruguay et l'Argentine, d'où nous recevons des bateaux chargés de blé, qui retournent vides à leur port d'origine.

On a écrit beaucoup sur la comparison entre le haut-fourneau au charbon et le haut-fourneau électrique, et très souvent j'ai eu l'occasion de lire de véritables hérésies à ce sujet.

Il n'est pas sans intérêt de rappeler et de mettre en évidence devant le Congrès Pan-Américain les erreurs que l'on commet d'habitude quand on établit le parallèle entre les deux systèmes. On compare en général la quantité de charbon dépensée dans le haut-fourneau avec le nombre de kilowatts nécessaire pour produire la même quantité de chaleur, et l'on en déduit les prix respectifs auxquels doivent être vendus l'électricité et le charbon pour que l'avènement du haut-fourneau électrique soit possible.

Ceci est parfaitement absurde. Le carbone dépensé dans un haut-fourneau au charbon peut être divisé en deux parties: l'une d'elles est employée à la fonction chimique de dérober l'oxygène au minerai; la seconde, combinée à l'oxygène de l'air que l'on injecte, doit produire la chaleur nécessaire à cette opération chimique.

Malheureusement, on ne peut arriver à produire seulement la quantité de chaleur strictement nécessaire. La combustion du carbone étant un phénomène reversible, comme presque toutes les opérations chimiques, une grande partie de l'acide carbonique produit avec dégagement de chaleur se décompose de nouveau au contact du charbon incandescent, en produisant de l'oxyde de carbone, ce qui absorbe de nouveau une très grande partie de la chaleur précédemment dégagée.

Cette réaction chimique, que nous pouvons appeler parasitaire, rend l'opération beaucoup plus couteuse qu'elle n'eût été si la totalité du carbone se dégageait par le gueulard sous forme d'acide carbonique.

Il ne faut donc pas oublier que la quantité de kilowatts théoriquement nécessaire devra être déduite, non pas de la quantité de carbone dépensée dans la pratique par les haut-fourneaux, mais plutôt de la quantité théoriquement nécessaire de carbone, s'il avait été possible d'obtenir dans le haut-fourneau l'oxidation complète du métalloïde. Or, cette quantité est minime.

La desoxidation du minerai de fer par le carbone est une opération exothermique! Quand on contemple un haut-fourneau, on ne s'en aperçoit guère,

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et c'est là un des côtés les plus curieux de la tournure de l'esprit humain qui, en général, a résolu jusqu'à ce jour tous les problèmes industriels en adoptant d'abord les solutions les plus complexes et apparemment presque absurdes, pour ne trouver que beaucoup plus tard les solutions simples.

La machine à vapeur elle-même est un exemple presque aussi frappant que le haut-fourneau, et cependant il est indéniable que, pratiquement, le moteur à gaz ou la turbine, beaucoup plus rationnels que la machine à vapeur et le haut-fourneau électrique, infiniment plus logique que le haut-fourneau au coke, n'ont pas encore pu supplanter leurs devanciers.

Cela m'entraînerait trop loin que de chercher les causes qui ont déterminé le succès de haut-fourneau. Il est cependant utile de rappeler que les minéraux pauvres dont on disposait en Europe rendaient très défavorable toute autre façon de procéder.

Evidemment, avec la combustion du charbon, on ne peut que difficilement et avec de grandes dépenses arriver à la haute température qu'exige la réduction des minerais riches.

Au Brésil, la nature prévoyante a placé à côté des chutes d'eau un minerai qui contient parfois 99 pour cent d'oxyde de fer. On est donc fortement tenté de placer dans un récipient un bain métallique chauffé par deux électrodes, de saturer ce bain de carbone, et d'y ajouter ensuite méthodiquement ce minerai idéal, tout en maintenant la proportion de carbone au voisinage du point eutectique.

La quantité d'électricité dépensée ne peut être que minime, car la chaleur dont nous avons besoin ne sert qu'à compenser strictement les pertes par radiation. Pas une seule calorie n'est exigée pour un travail chimique d'aucune sorte, ni pour une élévation quelconque de température.

Ce qui a beaucoup retardé l'avènement du four électrique, c'est que cette étude a été faite plutôt par des électriciens que par des métallurgistes.

On a voulu, dans le même récipient où l'on faisait la réduction du minerai, opération si simple, effectuer l'affinage, c'est-à-dire la décarburation ou la desoxydation. Ces deux opérations sont longues, et l'une d'elles surtout, la décarburation, se fait très mal dans une atmosphère aussi fortement carburante que celle du voisinage des électrodes.

Or, au four électrique, toute perte de temps se traduit par une perte d'argent, car l'électricité ne s'arrête pas de couler et qu'elle se paie très cher.

Donc, il faut diviser carrément les deux opérations, d'abord la réduction du minerai, ensuite son affinage, et cet affinage pourra très bien se passer de fours spéciaux car le Bessemer, qui ne dépense que du vent et de la force motrice, ne peut être, ou point de vue de l'économie, supplanté par aucun autre appareil. Et cette métallurgie pourrait être faite avec une dépense infime d'électricité, grâce a la richesse des minerais qui abondent au Brésil.

Il me semble, Messieurs, que je suis sorti un peu de mon sujet, mais cela était nécessaire car, dans l'état actuel de la science, si je ne montrais pas mon grand espoir dans l'avènement de la métallurgie au Brésil, toutes ces merveilleuses chutes dont je vous ai fait entrevoir l'existence ne nous apparaîtraient que comme d'inutiles ornements d'un paysage que personne ne va voir, et où il n'y aurait même pas un espoir de richesse et de prospérité.

The CHAIRMAN. We will now have an opportunity for the discussion of this paper, which gives a description of the directions in which electricity has been used in Brazil.

Mr. ROMMEL. I would like to ask how much electrification of the railroads of Brazil has taken place thus far.

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Mr. LEME. There are no electric railways in Brazil. The electric railways alluded to by me were tramways. There are one or two small mountain railways, but no trunk lines are electrified. It was the intention to electrify this railway in order to take out a large amount of iron ore, but unfortunately the war intervened and the project could not be carried out.

Mr. SUTTON. Mr. Chairman, I have been very much interested in this paper, because during the last six or eight years I have had occasion to investigate the hydrology of the region joining Brazil on the west—that is to say, the coast of Peru, 1,400 miles of coast line—and I have had occasion to study this same problem of electrification of railways there. I can appreciate fully the statement of the speaker when he says that the chief hope of that for the present lies in the electrochemical and the electrometallurgical processes. In Peru, for instance, there is no constant demand for power throughout the year in any of the processes that they carry on there with the exception of mining. In agriculture they need the power only about six months in the year, and they can transport those products only for a short period after the crop. Therefore, until the population of that country is very dense there can not be any constant demand for the power, and unless they can utilize that same industry on a constant output, you can not electrify those railroads on that basis.

The CHAIRMAN. If there is no further discussion, we will proceed to the paper entitled "Hydroelectric utilization at Niagara and elsewhere," by Mr. Maurice Deutsch.

## HYDROELECTRIC UTILIZATION AT NIAGARA AND ELSEWHERE.

By MAURICE DEUTSCH.

In every science of to-day the hypotheses of 20 years ago are already out of date. As expressed by one of our greatest scientists, Prof. Lester F. Ward, "Progress is nothing more than taking advantage of nature and turning it into useful channels so as to make it subserve the purpose of increasing human happiness."

Long before there was any anticipation of the present war the minds of the American people in every section of the country were aroused to the necessity of the conservation of our natural resources, this coming as a natural result of our internal economic conditions. And now the European war is emphasizing this to an extent far greater than any other influence could have done.

When the cry of "Conservation of natural resources" and "Preparedness" is synonymous then there should be no objection from any true American. But when preparedness is carried to extremes then there may be a waste of our natural resources to the great detriment of the people of the entire country and to posterity. Probably the most valuable natural resource, and one of the main

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assets, of the United States is its vast water powers. Unlike our coals, oils, natural gas, etc., it is inexhaustible and incalculable. The discovery of many of the latent forces in nature and the application by man of some of their potential energy has been the greatest influence in the development of modern civilization. Without the introduction of cheap sources of power many of the great industries of this country would have been stifled in their infancy. There is no country in the world that is as rich as the United States in the natural resources essential to "preparedness." The harnessing of its water powers and development of cheaper power will give a still greater impetus to the economic development of processes heretofore considered unprofitable.

While our supplies of coal, oil, copper, and other materials will last a great many years, their prices will increase or decrease as the demand increases and the supply diminishes. As a good example let me call attention to the high prices of coal, oil, gasoline, copper, etc., which to-day are higher than they have ever been before, some of these having doubled during the past one and one-half years. To be sure these prices have risen to a great extent as a result of this extravagant European war, but this will illustrate what we may expect as the extent of our natural resources diminishes.

Every waterfall is a thing of natural beauty which no lover of nature would wilfully care to destroy. Its use should be controlled and restricted by law for the benefit of the majority—the people. How to utilize such great and beautiful waterfalls and yet preserve their scenic attractiveness has been the cause of great controversy, whenever any water-power developments contemplating their use were planned, resulting in a certain retardation of industrial and economic progress in this country. The sketches which I herewith present are intended to demonstrate to what extent art may be the handmate of utility, if only the genius of the architect and the artist may be linked with that of the engineer.

It has been suggested that our beautiful waterfalls might be preserved for the æsthetic uplift of mankind by limiting the diversion of water from them to certain periods, as, for example, at night, when their view is less attractive to visitors than during the daytime, and that the spectacle of the regeneration of the falls when the diversion of water is stopped at a certain hour in the morning would be an unique attraction entirely new to this age of wonders. Such a plan of intermittent diversion of water would, of course, be only feasible if the electric current generated during the period of operation of the turbines could be utilized throughout the night and made effective for practical use throughout the rest of the day. Such a plan would be quite practical and feasible in the refrigerating and cold-storage industries where the brine at extremely low temperatures obtained during the operation of the turbines at night would still be of sufficient effectiveness to be used for circulation during the rest of the day, when the flow of water over the falls is not diverted. Such a plan if adopted should result in obtaining power required in refrigerating plants at lower costs than heretofore available and making it feasible for the clustering of large packing houses and cold-storage plants around such water powers as a center. Other industries would soon find some way by which they could adapt themselves to a plan which would enable them to secure much lower power rates.

The general clustering of electrochemical plants or other industries around water powers would be of great benefit to all industries, as a result of the cheapening of power and reduction in cost of transportation and other factors of economy which result from cooperation and combinations of this kind.

In trolley and lighting service the load of the plant is extremely variable with a large peak in the mornings and afternoons. During low loads engines

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are working inefficiently, and mechanical refrigeration lends itself to fill in the gap resulting, to a very great advantage in economy of operation.

In the United States one of our greatest problems of the future is that of "labor." In the past we have to a certain extent combated this problem by the introduction of labor-saving devices. But if in the development of industries for whose products we have heretofore been dependent upon foreign countries, this country is to be prepared to meet this competition of foreign countries where cheaper labor, power, and transportation facilities are more abundant than here, then we must look to the prompt and rapid development of our great natural resources of which our potential water powers furnish an immediate advantage.

### NIAGARA FALLS.

No more marvelous development of an industrial center has ever been dreamed of than that which has occurred at Niagara Falls during the past 23 years and brought about fundamentally by the utilization of only a small part of its potential water powers for the generation of electric current. Its population has been multiplied over four times (10,000 in 1892, 42,000 in 1915). Its assessed valuation has increased from $8,000,000 in 1892, when the city of Niagara Falls was formed, to over $37,000,000 in 1914, almost in direct ratio with the increase in population. The estimated investment in power development and manufacturing establishments at Niagara Falls is now over $75,000,000. The total value of the manufactures made at Niagara Falls annually amounts to over $40,000,000. It has now become the greatest center of the electrochemical industry in this country. Of the total value of products produced by the aid of electricity in 1909, New York State reported $13,401,878, or 72.6 per cent, of the output of the entire country. Of this amount $11,000,000 was made at Niagara Falls. There are now over 64 different industries in the city of Niagara Falls dependent upon Niagara Falls for their power.

The inexpressible grandeur of these falls has been a spectacle that has bewildered generations of people, but who would say that nature has intended Niagara solely to uplift mankind by its æsthetic grandeur? No matter how engineering science may utilize this great cataract for the benefit of the country its beauty should not and would not be neglected or destroyed. If some of the scenic beauty should be somewhat marred, this would be compensated by the beauty of the grand spectacle of the creation of a new and larger center of human activity.

At the present time a total of only 455,000 electrical horsepower is developed at the falls by five power companies, equally divided between the American and Canadian sides of the river. The average flow of the Niagara River is estimated by the Government engineers as about 222,400 cubic feet per second. The flow of this river is furnished by 6,000 cubic miles of water from four lakes, having 90,000 square miles of reservoir space. The drainage area that feeds this river covers 255,000 square miles, of which about 59.4 per cent lies on the American side of the boundary line. The annual rain and snow that falls over this watershed amounts to nearly 31 inches of water. The flow of water over these falls amounts to about 25,000,000 tons per hour—1 cubic mile per week. There is a fluctuation in the flow of the Niagara River which is caused by the direction of the wind, ice conditions in winter, and periodic variations in run-off, so that from measurements taken during the past 55 years the flow of the Niagara River has varied from about 158,500 cubic feet per second to over 314,000 cubic feet per second. So that considering the total fall in the river from about one-half mile above the falls to the pool below

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same, as being about 216 feet, there is a total theoretical power available of about 5,700,000 horsepower. Assuming a turbine efficiency of about 87 per cent (this has recently been carried to about 93 per cent), and a generator efficiency of about 92 per cent, the average available power would be about 4,500,000 electric horsepower. This may be reduced by reason of friction losses, etc., to a net 4,300,000 horsepower.

POWER COMPANIES AT NIAGARA FALLS—INSTALLATION HORSEPOWER.

| | |
|---|---|
| On American side: | |
| Hydraulic Power Co., of Niagara Falls | 144,000 |
| Niagara Falls Power Co | 118,300 |
| On Canadian side: | |
| Ontario Power Co., of Niagara Falls, Ontario | 120,000 |
| Canadian Niagara Power Co | 62,500 |
| Electrical Development Co., of Ontario (limited) | 52,000 |
| International Railway Co | 3,000 |
| | 499,800 |

Owing to the limitations set by the Burton law, passed in 1906, a diversion of only 15,600 cubic feet per second was permitted from the American side of the Niagara River; only 8,600 cubic feet per second by any one company; and only 160,000 horsepower could be imported from Canada. Subsequently, in 1910, by the terms of the international treaty between Canada and the United States, this restriction was changed to a daily diversion at the rate of 20,000 cubic feet per second on the American side and 36,000 cubic feet per second on the Canadian side. No restriction is placed upon the amount of power the United States may import from Canada. Although the Burton law expired in 1911, the War Department has exercised jurisdiction and control over the amount of diversion permitted. At no time have the full treaty limitations been allowed on the American side, although some of the companies are equipped to furnish the amount of power allowed by the international treaty. The Niagara Falls Power Co., for example, has an equipment capable of furnishing 100,000 horsepower of electrical energy, which was completed before the Burton law was enacted. The Burton law has limited the maximum production by this company to 90,000 horsepower. It would probably require a daily diversion at the rate of about 10,000 cubic feet per second to secure the full 100,000 horsepower. Its power houses now have an installed capacity of 115,000 horsepower. This company was the first to develop the water power on a large scale, and in order to avoid any commercial features below the falls, these power houses were located 1½ miles above the falls on the American side. As a result, a head of only about 140 feet became available. The turbines are set in a wheel pit cut out of solid rock, and about 180 feet deep. At the top of these pits are the power houses containing the generators. The water from the turbines drops to the bottom of the wheel pit, from whence it is discharged through a tunnel about 200 feet below the surface of the level of the river in the gorge below the falls.

The Hydraulic Power Co. is allowed a diversion of only 6,500 cubic feet per second. Its power house is located below the falls, where it has been possible to obtain an available head of about 216 feet. The water is led by way of a canal through the city from a point about 1 mile above the American Falls to a point less than one-half mile below the falls, from where it is discharged in 8 and 9 feet steel penstocks from the top of the gorge to the 13 turbine units

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below, each of a capacity of 10,000 horsepower. In order to improve the appearance of this installation, this company spent over $100,000 to construct an immense stone wall to cover these large penstocks.

The amount of diversion of water that has been permitted until now has produced no appreciable effect on these falls. Their appearance would no doubt be enhanced if a submerged dam were constructed near the crests and a low diversion dam constructed from the upper end of Goat Island to the international boundary line, solely for the purpose of preserving and improving the appearance of the falls and not for any increase diversion of water for power purposes.

The Niagara River descends 326 feet from Lake Erie to Lake Ontario. At Lake Erie the surface of the water is 572 feet above sea level, and at the first cascade it is 558 feet above sea level; only 14 feet drop. The descent from the head of the rapids to the crest of the American Falls (about one-half mile) is 46 feet. The water along the American side is very shallow and is not more than 18 inches deep.

The rock strata slopes from the American side toward the Canadian, so that there is a natural tendency for the water to flow toward the Canadian shore and away from the American Falls, so that we find near the American shore the water not more than 18 inches deep, while near the Canadian shore it is over 10 feet deep. The water is also deeper at the Canadian side of the crest than near the Goat Island side of the Horseshoe Falls.

While about 60 per cent of the total watershed feeding the Niagara River is on American soil, less than 5 per cent of the total discharge of the river passes over the American Falls. Sooner or later some means will have to be adopted to correct this flow of the Niagara River.

The height of the American Falls is 167 feet above the level of the river below. The width of the river at the Welland River is about 6,200 feet; at the head of the rapids just above Goat Island it is 4,100 feet; and the depth of the water nearly all the way across is less than 3 feet, except at the Canadian shore, where it is 9 to 10 feet. At the upper end of Goat Island, on the American side, the river is but 400 to 500 feet wide but widens to 1,000 feet at the crest of the American Falls.

The Canadian branch of the Niagara River is 3,200 feet wide at the head of the rapids from where it descends to the crest of the Horseshoe Falls, where it is 1,100 feet wide, The height of these falls is 158 feet at the Goat Island side and 165 feet at the Apex. It is worthy of note that the river bed is below the level of Lake Ontario, throughout the height of the gorge even at the foot of the falls, except in the whirlpool rapids. From measurements taken during the past 55 years it has been estimated that the Horseshoe Falls are receding at the rate of about 5 feet a year, while the American Falls have receded only about 0.25 foot a year. It is by a study of the recession and other geological phenomena at these falls that geologists have estimated their age to be from 32,000 to 39,000 years.

Upon a personal investigation at the falls a few weeks ago, I found that all of the factories are working to full capacity and are eager to secure additional power. One of the largest companies there has recently been obliged to set up a branch factory in Norway, where it was found they could secure a greater abundance of, and a much lower rate for power required for their industry.

This enormous supply of power has given a great impetus to the growth of many industries in which electricity can be utilized, so that we find located at Niagara Falls the greatest center of the electro-chemical industry on this continent. Notably among these are the processes requiring great heat, as the manufacture of calcium carbide, carborundum, aluminum, graphite, smelting,

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etc. Besides its local use in these industries the electric current is transmitted to Buffalo and Syracuse for light and power and also to Toronto, Hamilton, and London, Ontario. Besides this diversion of water at the falls water is also taken out for the Erie, Welland, and Chicago drainage canals. The two former, now being enlarged, will result in a still greater diversion from the Niagara River, and necessarily contributing to other causes affecting the flow over Niagara Falls.

### SOUTH AMERICAN WATER FALLS.

Three of the most interesting waterfalls in the world are to be found in South America—the Iguazu, Nacunday, and La Guayra. The Iguazu is probably the most interesting. Its height and volume of water are much greater than our own Niagara Falls. It enters the upper Parana at a distance of about 1,500 miles from the mouth of the river on the Atlantic coast, being at the junction of Argentina, Brazil, and Paraguay, and lies in the midst of a primeval forest. It is estimated that about 28,000,000 cubic feet per minute bursts through a series of thickly wooded islands and makes a clear leap at this point of 210 feet into the gorge below, which is known as the "Devil's Canyon." These located on the inner side of the bend are known as the Brazilian Falls. The other section, known as the Argentine Falls, has two leaps of 100 feet each. The width of these falls is about 6,000 feet in a straight line across, but taken around the broken contour of the edge of the cliff the length is about 13,000 feet. The river above the falls is 3,000 feet, while the gorge below is a canyon about 400 feet wide. Flood rise in the wide upper section of the stream is about 10 feet, while in the so-called Devils Canyon in the gorge there is sometimes as much as 120 feet difference in the level between high and low water.

The Iguazu is more than double the width and a third higher than the Niagara Falls. On the Alto-Parana, about 4 miles below the junction with the Iguaza, comes the River Nacunday from the Paraguayan side. A few hundred yards in back of this junction are the falls of Nacunday, a straight uniform cataract fully 50 feet in height and about 250 feet wide.

About 200 feet above the entrance of the Iguazu on the Parana River there are the Falls of La Guayra, which are said to be 310 feet high and only 250 feet in width at the narrowest point, with an estimated flow of over 13,000,000 cubic feet per minute. The physical conditions around these falls make them in every way a natural water power, requiring only the installation of power houses and penstocks, enabling millions of horsepower to be developed. While the journey from the Atlantic coast to these falls takes about 12 days, the distance, "as the crow flies," to the extensive markets for power along the Atlantic coast is not more than 400 miles. While no transmission lines of that length have yet been constructed, the problems involved, no doubt, can be solved by the engineer should the occasion arise. This entire country is wealthy in timber and other natural resources, waiting only the assistance of capital for its exploitation.

### RECENT PROGRESS IN HYDROELECTRIC DESIGN.

During the past few years improvements in design have occurred which will have a far-reaching effect and give an added impetus to the development of water powers, particularly those of the smaller heads heretofore considered uneconomical.



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Some of the most notable hydroelectric developments during the past few years are the following:

The Auglaize and Maumee River power developments, which will ultimately generate 37,500 to 40,000 horsepower from four plants from an effective head of about 26 feet, will distribute power within a radius of 60 to 75 miles to cities in the vicinity of Fort Wayne, Ind., and Toledo, Ohio.

The most remarkable development in recent years is that of the Big Creek, a tributary of the San Joaquin River, on one of the most inaccessible sites in the Sierra National Forest Reserve, 250 miles northeast of Los Angeles, Cal., and at an elevation of 7,000 feet above sea level. The snow water from mountains 10,000 feet high is stored and fed to two power plants, each utilizing in turn heads of nearly 2,000 feet in horizontal distances of 2 miles to the first station and 4 miles to the second. Power is to be transmitted 241 miles to Los Angeles at 150,000 volts for industrial, lighting, and street-railway use. The present plant has a capacity of about 80,000 horsepower, but it is ultimately to be developed for 400,000 horsepower.

Another low-head, single-runner hydroelectric development has just been completed this year at Coons Rapids, on the Mississippi River, 13 miles above Minneapolis. This will ultimately provide about 3,200 horsepower from an average head of about 17½ feet.

The Coosa River project is the first of a number of hydroelectric developments by the Alabama Power Co., at central Alabama, about 40 miles from Birmingham. The maximum distance of transmission is 150 miles. This company is largely financed by English capitalists. The present power house will provide for the installation of six 12,500-horsepower main units, operating under a 68-foot head, and a voltage of 110,000 volts. It is ultimately to have a capacity of 400,000 horsepower.

Another interesting station just completed is that of the Horseshoe Falls, on the Bow River, about 50 miles west of Calgary and three-fourths mile from the main line of the Canadian Pacific Railroad. Above this site the river has a drainage area of about 2,000 square miles. By the use of two 12-foot and two 9-foot penstocks, operating under a head of 70 feet, 19,500 horsepower is being generated for distribution 8 miles to the Exshaw cement plant, at 12,000 volts, and at 55,000 volts 50 miles to Calgary.

The most notable features of the Salmon River power development is the regulation of a water column 9,625 feet long and the installation of four needle valves 8 feet in diameter. To absorb the energy of the water in this long pipe a differential surge tank 205 feet high had to be installed. Bypasses provided at the turbines avoid putting the entire burden of regulation on the tanks. The needle valves, which are 8 feet in diameter, are of special interest, as they were tested for several years at the Ontario Power Co.'s station at Niagara Falls, where the valves are 9 feet in diameter. This station develops 30,000 horsepower under a head of 245 feet. The Salmon River flows from the foothills of the Adirondack Mountains and has a fall of 650 feet in the 17 miles between Stillwater, N. Y., and Lake Ontario, and 400 feet in a distance of less than 8 miles. Next to Niagara Falls the Salmon River is the best source of power in the State of New York. At the Salmon Falls, which are almost as beautiful as the Niagara Falls, the drop is 100 feet. This station is peculiarly well adapted for pumping water back to the reservoir with power from Niagara Falls. The Salmon River line is to be tied in with the Niagara Falls plant of the Ontario Power Co., acting in general as a source of energy, but occasionally as a synchronous condenser plant. During hours of low load it will be shut down, but at peak loads its main function is developed. Due to insufficient storage facilities it becomes necessary (as has

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been done in several instances in Europe, in one case pumping water over 1,500 feet up on a hillside) to pump back into the reservoir during low flow in the Salmon River, to be used at times of peak loads later in the day, enabling the plant to take care of peak loads nearly twice that otherwise possible.

The highest head hydroelectric plant east of the Mississippi River is that of the Georgia Railway Co. at Tallulah Falls, situated on the eastern slope of the Blue Ridge Mountains in Rabun County, Ga. Current is transmitted a maximum distance of 210 miles to Lindale, Atlanta, and vicinity. It was put in operation in September, 1913, with a present capacity of 67,000 horsepower under a 580-foot head. Its ultimate capacity will be about 84,000 horsepower. This development involves the interesting construction of an artificial reservoir with a capacity of 1,000,000,000 cubic feet, formed by two reinforced concrete dams located at Mathis, Ga.; an artificial reservoir of a capacity of 63,000,000 cubic feet located at Tallulah Falls; a tunnel 6,665 feet long leading from the latter reservoir to a surge tank 80 by 71 feet and 93 feet high and 5 feet in diameter, steel penstocks, each of which serve one unit in the power house. The automatic flashboards have never before been used in this country.

One of the most notable of recent power developments is that on the Ocoee River at Parksville, Tenn., in 1912 the first plant developing 27,000 horsepower from a head of 110 feet. Development No. 2 utilizes a head of 272 feet for an ultimate installation of 80,000 horsepower. The maximum flow of water—1,200 cubic feet per second, is carried in a flume 14 feet 2 inches wide, 29 feet 9 inches deep, along the mountain side for about 4½ miles to the penstock intake. In order to take care of the surplus discharge when part or all of the load on the station is suddenly thrown off the turbines a spillway is provided near the lower end of the flume and about 800 feet above the penstock intake. In view of the insufficiency of the available length of crest to discharge the 1,200 cubic feet per second eight automatic siphon spillway units were installed within the concrete of the spillway dam. Although this is the first design of such a siphon in this country, it has proven highly efficient.

In power output and especially in physical magnitude by far the largest hydroelectric power plant in the world is that at Keokuk, Iowa, on the Mississippi River. The ultimate installation contemplates 80 turbines, each having a rated capacity of 10,000 horsepower at the normal head of 32 feet; at the maximum head of 39 feet the output of each of these will be about 14,000 horsepower, and at the minimum operating head of 20 feet approximately 6,000 horsepower. The operating voltage is 110,000 volts.

Owing to arrangements which this company has with a large auxiliary steam plant at St. Louis, to whose switchboards a large part of the output of the Keokuk plant will be furnished, a primary load of more than 200,000 horsepower will always be commercially available, even under the worst conditions. This power plant is about 220 miles west of Chicago, 180 miles east of Kansas City, 140 miles north of St. Louis, and the center of a population of about 4,570,000 within a distance of 220 miles.

The Klamath River hydroelectric development of the California-Oregon Power Co. is situated 13 miles east of the Southern Pacific Railroad station at Thrall, Cal. This company is now distributing 20,000 horsepower in a 10,000 square mile territory in southern Oregon and northern California. The plant recently completed will furnish 53,000 horsepower.

One of the largest water powers in this country will be the Mount Shasta Power Co.'s development now in progress on the Pitt River near Redding Cal.,

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at the head of the Sacramento Valley. Its position will enable it to furnish power to the mining interests and mountain railroads of northern California and to all towns and cities as far south as San Francisco and Oakland, at a maximum transmission distance of 224 miles. The interesting features are the construction of the largest water-power tunnels in the world, 16 by 19 feet and 36,753 feet long. The distance from the intake portal of the tunnel to the power house will be a little less than 9 miles. It is expected that with a maximum flow of 2,450 cubic feet per second under the static head of 939 feet that a net power at the feeders of 200,000 horsepower will be obtained.

The Alameda River Hydro-Electric Co. contemplates the development of 25,000 horsepower from three power plants located in the State of Morelos, about 50 miles from the city of Mexico, where the electric current is to be sold. The first of these power plants was started in 1912. The two 4,000 horsepower Escher Wyss turbines were made in Switzerland, while the rest of the equipment was brought from Germany, including two 1,500-horsepower Diesel engine generating units, the largest of their kind in America.

The McCall Ferry development on the Susquehanna River under the most favorable conditions will have a maximum capacity of 135,000 horsepower. By the construction of a dam 3,000 feet long and 50 to 100 feet high, 32,000,000,000 gallons of water are impounded.

In the south-central part of Wisconsin on the Wisconsin River, near Prairie du Sac, a power development has been started which will have an ultimate capacity of 25,000 horsepower operating under a 25-foot head.

One of the most interesting of recent hydroelectric improvements is that of the Pirahy plant of the Rio de Janeiro Light & Power Co., on the Lages River in Brazil. The original plant had six vertical shaft impulse wheels of 9,000 horsepower, each of which furnished power and light to Rio de Janeiro. The maximum distance of transmission is 51 miles. Another indication of the wonderful rapid progress of South American cities, and brought about primarily as a result of the introduction in these cities of cheaper power, is that this 54,000-horsepower plant has already outlived its original designed capacity. The power house was enlarged so as to make room for the two largest impulse turbines built to date, each capable of producing 20,000 horsepower, making a total available power capacity of 94,000 horsepower. These wheels operate at a speed of 300 revolutions per minute under a net head of 900 feet. Two relief valves at the bottom of the penstock connected to the governor are automatically controlled by the latter, in order to keep the pressure in the penstock within safe limits in the event of sudden change of load.

In 1914 the São Paulo Electric Co. started its plant at São Paulo, Brazil. Its present capacity is 40,000 horsepower, and transmits current at 88,000 volts 56 miles to Sorocaba and vicinity. Ultimately it will have a capacity of 67,000 horsepower. One of the largest units ever designed is used in this plant. At a head of 600 feet its capacity is 14,500 horsepower.

Other recent water-power developments operating at and above 70,000 volts are given in table, page 160 opp.

During the enormous activity in the development of great water powers in the past 10 years, the smaller, more easily available water powers have been lost track of. Very little has been done in this country to develop the more general use of small powers of less than 300 horsepower, while abroad, notably in France considerable progress has been made. We find there that individuals along the smaller streams have found it practicable and profitable to develop these small powers. A greater impetus would be given to the development of such small powers if cooperation between one or more of such neighboring developments could be secured, resulting in a greater economy and elasticity of operation.

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A very interesting power development for an unusual range of very low heads has recently been completed at Chester, England, on the River Dee. The flow in the river varies from 5,000 cubic feet per second in December to 167 cubic feet per second minimum in dry weather. There are three vertical-shaft Francis turbines designed for working heads from 1 to 9 feet. Two will pass a maximum of 500 cubic feet per second of water, each at 9-foot head, developing 415 horsepower at 50 revolutions per minute, while the third develops 305 horsepower at 55 revolutions per minute, with 367 cubic feet per second under 1-foot head. The larger turbines at full gate pass 167 cubic feet per second, developing 15.3 horsepower at 16.5 revolutions per minute. The smaller machine, under 1-foot head, draws 123 cubic feet per second and develops 11.4 horsepower at 18.6. The turbines and generators were specially designed to work efficiently over such a wide range of speeds. The operation of this English plant seems like "bringing coal to Newcastle," but its low cost of operation should be of special interest to all owners of riparian rights on the vast number of the smaller streams in North and South America, which generally are nearer the large markets than the source of the great water powers, and hence less costly to reach. One unit is used with the dry-weather flow, two for average conditions, and three for wet weather low-head flow. The annual output is expected to be about 1,250,000 kilowatt hours and the cost 0.7 cents per kilowatt hour, including capital charges. The labor cost is low, three men working in eight-hour shifts. How remarkable this is when we compare it with conditions in New York City, where over 2,000 kilowatt hours must be consumed per month in order to get a rate of 4½ cents per kilowatt hour.

In the development of these various plants during the past few years many improvements in design have occurred. Five of the largest dams in the world are under construction in the West. The gravity section is still more generally used, but other types have come into use during recent years; automatic dam gates having an overhead movable roller and other installations of direct counterweighted flashboards have been used in the Tallulah Falls plant. For longest distances wood stave pipes have been used most. The longest to date is 5,070 feet long and 13½ feet in diameter. For the very high heads welded steel pipe and for lesser heads riveted steel pipe have been quite satisfactory.

While formerly the gravity water wheels were used to a greater extent than reaction or impulse wheels, the practical water prime movers to-day have been reduced to two—the Francis turbine and the impulse wheel. These have been applied to a range of head from 6 to over 5,000 feet. With the marked advance in the workable speed of these machines it is now possible to develop water power under heads heretofore considered impracticable. A single-runner high specific speed mixed-flow Francis wheel has recently shown an efficiency of 93.7 per cent.

The largest single units ever constructed are the 17,000 horsepower vertical Francis turbines installed at Tallulah Falls. These operate under a head of 600 feet. Manufacturers now inform us that 40,000 horsepower units are quite practical if the demand arises.

The improvements in governors and other regulating devices giving greater flexibility and reliability have given engineers the greatest confidence in the design of such enormous power plants. The limitations are greater now from the electrical than from the hydraulic end of these large water powers.

### ELECTRIC POWER HIGH-VOLTAGE TRANSMISSION.

Niagara Falls power is transmitted to Syracuse and Oswego, 200 miles, at 60,000 volts. The Southern Sierra Power Co. transmits power from Bishop,

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Cal., to San Bernardino, Cal., 238 miles, at 150,000 volts. The Province of Ontario has been delivering Niagara power 130 miles, and is continuing its line to Windsor, 235 miles, at 110,000 volts. Already improvements are at hand permitting a still larger transmission at a voltage of 150,000. The standard generating voltages are 2,200, 6,600, and 11,000, the choice being governed by the speed and capacity of plant. Standard transmission voltages are 11,000, 33,000, 66,000, 110,000, and above, depending on the amount of power and distance transmitted.

During the five-year period up to 1913 improvements in insulation brought the voltages from 10,000 to 120,000, made possible by the invention of the suspension insulator. At the end of 1913 a further increase was attempted in the notable transmission from Big Creek to Los Angeles, Cal., 240 miles, at an initial pressure of 135,000 volts, to be raised to 150,000 as the load demands.

A few years ago the greatest trouble was had with high-tension transformers, which American manufacturers have now entirely overcome. We find that in some of the biggest foreign plants the engineers have found it desirable to come to the American manufacturers for transformers even when the rest of their plants were of home manufacture. If such a remarkable advance has been possible within the last 10 years an even greater progress is expected with any demand for larger transmission requirements.

No less than 35 plants are now running at or above 100,000 volts working pressure, and a transmission from 100 to 200 miles is now quite commonplace. Although the difficulties are tremendous it will not be long before the maximum of 150,000 volts and 240 miles transmission will soon be excelled. In these plants nearly 1,800,000 kilowatts are installed, and in many cases an ultimate development of two to three times the intial layout is provided for. (See table on p. 160 opp.)

One of the most interesting tables that has been recently compiled in giving valuable data as to high voltage transmission lines is that of Mr. Selby Haar, published in the Electrical World, of April 25, 1914, and which is reproduced herewith. (See table, p. 160 opp.)

Thirty-one plants operate at or above 100,000 volts. All but one-half of these are on this continent and most of them in the United States; all but one are three-phase plants. About 40 per cent of the total list of plants are operated at 60 cycles, 30 per cent at 50, and the rest at other periodicities, mostly 25 cycles. There seems to be a strong tendency to use single-phase units in the transformers, although quite a few plants use the three-phase type.

Mr. Samuel Insull, of Chicago, the greatest authority on large centralized plants in this country, states that he has found that where there is a low price per kilowatt hour there is a high figure of sales per capita; that per capita sales of electric current have passed that of gas in this country. All of the great water powers of the West are in the category of properties which show a low income per kilowatt hour, high output per capita, and extremely high load factor. Except on the lines of the railroad, it is unusual to find any steam plants in the districts where hydroelectric plants operate. Western mountain lines are rapidly undergoing electrification, and it will not be long before this application of electric energy will be largely extended.

The utilization of any source of potential energy, as, for example, coal, oil, or water, to obtain useful work, constitutes merely the transformation of one form of energy into another. While energy is indestructible it is interesting to compare the percentages of actual useful work that can be obtained from any one of these sources by the best known form or system of mechanism and

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machinery utilized in the transformation of transmission of the energy. Prof. Daniel W. Mead gives three interesting tables of comparison, which I have taken the liberty of reproducing here.

EXAMPLE OF ENERGY LOSS IN WELL-DESIGNED STEAM POWER PLANT.

[By Prof. Daniel W. Mead.]

| | Per cent lost. | Per cent efficiency. | Net efficiency from potential source. |
|---|---|---|---|
| Furnace | 20 | 80 | 80 |
| Boiler | 15 | 85 | 68 |
| Steam pipe | 5 | 95 | 64.6 |
| Engine | 94 | 6 | 3.87 |
| Belt | 5 | 95 | 3.67 |
| Shafting, belts, and counter shafts | 40 | 60 | 2.2 |
| Lathes or other machine tools | 50 | 50 | 1.1 |
| Percentage of original energy utilized in useful work | | | 1.1 |

EXAMPLE OF ENERGY LOSS IN HYDRAULIC PLANT FOR ELECTRIC LIGHTING.

| | | | |
|---|---|---|---|
| Head and tail races | 5 | 95 | 95 |
| Turbine | 20 | 80 | 76 |
| Gearing | 15 | 85 | 64.6 |
| Shaft | 5 | 95 | 60.37 |
| Belt | 5 | 95 | 57.35 |
| Generator | 8 | 92 | 52.76 |
| Line loss | 10 | 90 | 47.48 |
| Transformer | 20 | 80 | 37.98 |
| Lamp | 80 | 20 | 7.60 |
| Percentage of original energy utilized in useful work | | | 7.60 |

EXAMPLE OF ENERGY LOST IN STEAM AND ELECTRIC PUMPING PLANT.

| | | | |
|---|---|---|---|
| Boiler and furnace | 30 | 70 | 70 |
| Steam pipe | 5 | 95 | 66.6 |
| Engine | 90 | 10 | 6.65 |
| Belt | 5 | 95 | 6.32 |
| Generator | 20 | 80 | 5.06 |
| Line | 10 | 90 | 4.55 |
| Motor | 10 | 90 | 4.09 |
| Pump | 25 | 75 | 3.06 |
| Suction and discharge pipe | 20 | 80 | 2.45 |
| Percentage of original energy utilized in useful work | | | 2.45 |

In a well-designed steam power plant he estimates that only 1.1 per cent of the original energy is utilized in useful work, such as the operation of lathes or other machine tools; that only 7.6 per cent of the original energy of a potential waterfall is utilized in electric lighting or other useful work, while in the operation of a steam and electric pumping plant only 2.45 per cent of the original energy is utilized in the pumping operations. In 1900 a consumption of 6.9 pounds of coal was required per kilowatt hour. In 1913 the best record was obtained with 2.87 pounds per kilowatt hour. These percentages have been somewhat improved during the past five years, but it is evident that the hydroelectric plant is the most efficient arrangement of machinery for obtaining useful work from the original source of the potential energy.

The cost of a water-power plant varies considerably with local conditions. At Niagara, the cost per horsepower varies from $80 to about $114 (from the first report of hydroelectric power commission of the Province of Ontario) for a 24-hour plant on three plants varying in capacity 50,000, 75,000, and 100,000 horsepower, respectively. Depending whether the development includes the construction of dams, storage reservoirs, electrical equipment and transmission line, etc., a study of a large number of American and European plants shows a

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variation in cost per horsepower of from $50 to $375 per horsepower. The usual cost varies from $100 to $200 per horsepower.

COST OF POWER.

From the Ontario commission's report, the following table, showing the variation in cost of power from the generating plant to the consumer, is of interest as showing the low cost of power transmitted 100 miles from Niagara Falls to points in Ontario, Canada:

PER HORSEPOWER YEAR.

| Amount of power delivered. | At Niagara Falls, including line and step down substation losses. | To substation. | To customer. |
|---|---|---|---|
| Full load, 2,000 horsepower | $18.54 | $21.89 | $26.03 |
| Three-fourths load, 1,500 horsepower | 13.18 | 23.54 | 29.06 |
| One-half load, 1,000 horsepower | 12.85 | 27.21 | 34.48 |

At Niagara Falls and immediate vicinity power in large quantities is now sold under contract as low as $20 per horsepower per year, which is about 0.3 cent per kilowatt hour. To be a success any water-power plant must be able to sell power to the consumer at a cheaper rate than that already on the market.

The Niagara Falls Power Co.'s schedule for standard 10-hour meter power gives a rate for a maximum use of 100 horsepower and an average use at 75 horsepower for a month of 250 hours at an aggregate price of $144.67. This compares as follows with the reported charges in seven important cities:

| | |
|---|---|
| Brooklyn | $492.78 |
| Boston | 371.24 |
| Philadelphia | 839.25 |
| New York | 624.90 |
| Chicago | 458.92 |
| Cleveland | 559.50 |
| Rochester | 419.62 |

Niagara Falls, $144.67.

In compliance with a recent order of the public-service commission, rates for electric service in New York City have been substantially reduced. The following table shows the cost of electric service for stated conditions under the reduced New York City rate schedule, compared with the cost at Niagara Falls, N. Y., under the established rate schedule of the Niagara Falls Power Co.:

| | Cost in New York City. | Cost in Niagara Falls. |
|---|---|---|
| Maximum use, 5 horsepower; average use, 3.75 horsepower; 10 hours per day, 25 days per month | $52.18 | $9.84 |
| Maximum use, 10 horsepower; average use, 7.5 horsepower; 10 hours per day, 25 days per month | 94.36 | 19.68 |
| Maximum use, 25 horsepower; average use, 18.75 horsepower; 10 hours per day, 25 days per month | 192.63 | 54.17 |
| Maximum use, 50 horsepower; average use, 37.5 horsepower; 10 hours per day, 25 days per month | 343.70 | 81.11 |
| Maximum use, 100 horsepower; average use, 75 horsepower; 10 hours per day, 25 days per month | 624.90 | 144.61 |
| Maximum use, 500 horsepower; average use, 375 horsepower; 10 hours per day, 25 days per month | 2,101.25 | 652.70 |
| 500 horsepower used continuously for 24 hours every day in the month | 6,277.08 | 833.33 |
| Maximum use, 1,000 horsepower; average use, 750 horsepower; 10 hours per day, 25 days per month | 4,552.08 | 1,285.50 |
| 1,000 horsepower used continuously for 24 hours every day in the month | 11,752.00 | 1,666.66 |

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The recent progress and development in the extraction of oxygen, hydrogen, and nitrogen from the air has been commercially possible where the lowest rates for power have been available. Two firms in Germany require 6 kilowatts per hour per cubic meter of hydrogen, where electric power costs 80 marks ($19.04) per horsepower year, as is frequently the case in Germany. This means an outlay of 7½ pfennigs per cubic meter of hydrogen for electric energy, or 9 cents per pound.

The recent rapid industrial progress in Norway and Sweden has been truly marvelous, and is comparable with our own Niagara Falls, both resulting from the development of its water powers. The air-nitrate industry of Norway is to-day the largest in the world, and was made possible by the utilization of electric power obtained from its numerous waterfalls at rates varying from $1.90 per horsepower year at Odda to $12 per horsepower year in eastern Norway.

Wherever heavy precipitation combined with great elevations can be found, as in parts of Alaska, at all of our large mountain chains, the Rockies, Appalachian, Adirondack, Blue Ridge, the eastern slopes of the Andes and others in North and South America, water power could be developed where rates as low as any in Europe will be possible.

In the Province of Ontario, Canada, electricity is sent 200 miles at a loss of not in excess of 6 per cent, and competes with gas at 60 cents per thousand cubic feet. In New York City a few years ago gas was sold at $1 per thousand cubic feet, and is now selling at 80 cents per thousand cubic feet. Ninety-nine per cent of the houses in Ottawa, the capital of Canada, are lighted by this cheap electric current. In that city one of every five inhabitants uses electricity, while in Albany, a city of the same size, the ratio is 1 to 20, and in New York City 1 to 35.

The ordinary small workingman's house pays less than $1 per month for lighting, while a 14-room house using 30 lamps of varying sizes costs an average of $2 per month, which prices are about one-half that in New York State.

In Ottawa for continuous power the price is $22.30 per horsepower per annum and a much lower rate for power in the summer season and for restricted use. The price of power depends on the distance the power current is transmitted. In Toronto, 90 miles from Niagara Falls, the city buys power at $18.50 per horsepower and sells 10-hour power at $28.

### FEDERAL AND STATE COOPERATION IN WATER-POWER CONTROL.

During the past 20 years as a result of the tremendous extension of the use of water power throughout every State of the Union their dual control by the Federal Government and the sovereign State has brought about a great deal of discussion and controversy involving limitations as to the development of small and large potential water powers. Control by the former arising from the ownership of public lands, jurisdiction over navigable national and State boundary streams, and by the latter from individual State laws governing the appropriation of water, has in some cases been incompatible with local industrial development; but during the past few years a great deal has been accomplished by a spirit of cooperation between Federal and State authorities, which is rapidly spreading to every part of the country and resulting in a greater practical solution by our legislators of legal difficulties which have been the main cause of the retardation of the greater engineering and industrial development of our natural resources.

What has been accomplished out West is significant of what the National Government is endeavoring to accomplish toward the conservation of our

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natural resources, so important to the greater national as well as State industrial development. As an example of the harmony between the Federal and State Governments which has been in existence for the past five years, I quote from the regulations of the Secretary of Agriculture, effective February 1, 1915, as follows:

Wherever the approval of a State administrative official board or commission is a condition precedent to the right of either to take and use water for power purposes or to engage in the business of the generation, transmission, or distribution of power certified evidence of such approval must be filed before a final permit will be issued. Formal notification by such official, board, or commission that the water right has been cancelled or that the permission to engage in the power business withdrawn, will be deemed sufficient grounds for the revocation of the permit.

During this time no permits have been issued to anyone for the construction of a water-power plant on public lands without first securing a water right from the State. A few months ago the Secretary of Agriculture refused certain rights of way in the Inyo National Forest to a company whose previous application for the privilege of using the water of certain creeks had been rejected by the State Water Supply Commission of California, on the ground that the public interest so demanded. The streams referred to are located entirely within the National Forest Reserve, and this company argued that, therefore, the State authorities had no say in the matter. But the honorable Secretary A. F. Houston in his decision stated that "it is believed that better results can be secured under existing conditions by cooperative action between the State and Federal authorities than by any insistence upon strict legal rights on behalf of either."

It is hoped that other States will soon see the advantage that would accrue from similar cooperation.

In New York State the control of private projects, as well as the inception and execution of public projects involving the appropriation of State waters, has been placed in the hands of a single State commission with ample and far-reaching powers. For greater harmonious control and supervision, legislation should contemplate a more comprehensive policy, which will treat each stream as a unit from its source to its mouth and take into consideration all possible uses of the water. Private initiative should be encouraged by granting, under State government control, appropriate powers which will give sufficient impetus to the investment of capital; and to insure harmonious development of various projects within the same drainage basin, cooperative legislation should be sought.

The principle of the Newlands bill, presented last year in Congress, is that all Government activities having to do with the use and conservation of water must be placed under the jurisdiction of one body. Such a body would have within its scope river and harbor improvements, irrigation, drainage, flood protection, hydroelectric development, etc.

It is to be hoped that the coming year will see the adoption of at least some of the excellent legislative regulations governing the development of water powers now pending before congressional committees. The great commercial development to which we all look forward and expect in all North and South American countries after the war would be stimulated by immediate progressive legislation which would conserve the interests of the Government and promote the development of powers now going to waste.

The problems confronting and the work undertaken by the people of the State of New York in their efforts to conserve their natural resources are pertinent and of timely interest to every other community. Its conservation commission

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has made comprehensive hydrographic surveys, and at the present time there is available reliable data showing the power possibilities of every important inland river within the State. It has been found that it is commercially feasible to develop at least 2,500,000 horsepower within the boundaries of this State, having a population of nearly 10,000,000 inhabitants. This is more than sufficient to supply all the needs of the State for light and power for manufacturing and industrial enterprises. This total does not contemplate the complete use of all of the potential water powers of the Niagara River or of the St. Lawrence, the utilization of which is restricted by international treaty limitations. Approximately 1,000,000 horsepower has already been developed, leaving about 1,500,000 horsepower to be developed.

The policy which this State is to adopt with respect to its developed and undeveloped powers has been a subject of very heated discussion by its legislators during each of the past five years, but will soon have to be definitely settled.

As a result of recent development in long-distance transmission power can now be distributed to users within an area of over 100,000 square miles. As a result water power which, within recent generations, was a matter of only local interest, now commands national as well as State attention in order to preserve the best interests of all the people. Therefore in its preparation for defense in case of war or in the economic development during peaceful times of a country as extensive in area and as rich in natural resources as the United States, no more important problem confronts its people than the prompt and efficient utilization of the great potential powers with which nature has so richly endowed it. Every phase of its present or future status among the nations will depend fundamentally upon its ability to obtain cheaper power for its ever-increasing industries in order to compete and as an offset to the already developed low electric current obtained from water falls and the cheaper labor available in European countries. What is true in this respect as regards the United States applies equally well to all of our progressive Pan American countries.

No. 1. There is therefore urgent necessity for developing our water powers as promptly and efficiently as possible.

No. 2. The immediate need for the formulation of a definite policy with respect to water powers which will be equally observant of the Federal, State, and private riparian rights.

### WATER POWERS OF THE UNITED STATES.

The total stationary power now used in the United States, steam, water, and gas, is probably over 30,000,000 horsepower, according to an estimate of the United States Geological Survey as published by the United States Commissioner of Corporations in his report of 1912. Our total developed water power is about 6,000,000 horsepower. The United States Geological Survey estimates the "minimum potential" water power of the country at 36,916,250 horsepower, and the assumed maximum at 66,518,500 horsepower, both figures excluding any estimate of storage possibilities, which latter we must not forget will have an additional enormous economic value in the prevention and control of floods throughout the country, as well as greatly increasing this estimate of power. But the estimate of storage possibilities is very difficult to arrive at. In the above estimate the survey has included 5,800,000 minimum horsepower and 6,500,000 maximum horsepower for Niagara Falls. But at the present time by the international treaty between the United States and Great Britain only 25 per cent of this theoretical horsepower can be developed, and only

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five-fourteenths of the power made available thereby belongs to the United States, its share being reduced because of the diversion of water from Lake Michigan into the drainage canal at Chicago. There is therefore left a minimum at Niagara Falls of 578,000 horsepower that can be developed on the American side. The above estimate did not include any power for Pennsylvania, because data was not available at the time. For Pennsylvania there must be added 331,000 minimum horsepower and 821,000 horsepower assumed maximum, making corrections as per the above data—the survey figures would be 32,083,000 horsepower minimum and 61,678,000 horsepower maximum for the entire country. (As corrected by the United States Commissioner of Corporations.)

According to the statistics of 1905–1907 the total installed stationary prime moving power of all kinds—steam, gas, water—in the United States was approximately 23,000,000 horsepower. Of this 18,858,000 horsepower, or 82 per cent of the total, was generated by steam; 3,423,000 horsepower, or 15 per cent, was developed from water; while 631,000 horsepower, or about 3 per cent was generated from internal-combustion engines. The total horsepower developed in the entire South, according to the census of the Manufacturers' Record (Blue Book, Baltimore, 1911), was as per table:

| | Horsepower developed. |
|---|---|
| Fifteen States, 1908 (13,040 plants) | 979,840 |
| United States: | |
| 1880 | 1,225,379 |
| 1908 | 5,356,680 |

Since 1907 there has been a more rapid development of water power than during any five-year period theretofore. But it is not exactness of figures that is aimed at in this discussion as much as to convey some idea as to the enormity of the power resources of this country and what no doubt must be similarly available in other countries of this great hemisphere.

*Report of Commissioner of Corporations on water-power development in the United States, 1912.*

[Potential water powers in the United States, by States, as computed by the United States Geological Survey and as revised by the Bureau of Corporations.]

| | Potential horsepower on basis of 90 per cent efficiency. | | Potential horsepower on basis of 75 per cent efficiency. | |
|---|---|---|---|---|
| | Minimum. | Assumed maximum. | Minimum. | Assumed maximum. |
| United States | 32,083,000 | 61,678,000 | [1] 26,736,000 | [1] 51,398,000 |
| North Atlantic States: | | | | |
| Maine | 532,000 | 971,000 | 443,000 | 809,000 |
| New Hampshire | 162,000 | 295,000 | 135,000 | 246,000 |
| Vermont | 113,000 | 206,000 | 94,000 | 172,000 |
| Massachusetts | 142,000 | 273,000 | 118,000 | 228,000 |
| Rhode Island | 7,000 | 16,000 | 6,000 | 13,000 |
| Connecticut | 86,000 | 164,000 | 72,000 | 137,000 |
| New York | 1,244,000 | 2,037,000 | 1,037,000 | 1,698,000 |
| New Jersey | 53,000 | 127,000 | 44,000 | 106,000 |
| Pennsylvania | 331,000 | 821,000 | 276,000 | 684,000 |
| South Atlantic States: | | | | |
| Delaware | 6,000 | 13,000 | 5,000 | 11,000 |
| Maryland | 51,000 | 146,000 | 43,000 | 122,000 |
| District of Columbia | 6,000 | 13,000 | 5,000 | 11,000 |
| Virginia | 590,000 | 1,144,000 | 492,000 | 870,000 |

[1] This total is arrived at by deducting one-sixth from the total of the 90 per cent efficiency basis; the sum of the items in this column exceeds the total by 7,000 horsepower, due to the fractional gains in making one-sixth reduction for the individual States.

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*Report of Commissioner of Corporations on water-power development in the United States, 1912*—Continued.

| | Potential horsepower on basis of 90 per cent efficiency. | | Potential horsepower on basis of 75 per cent efficiency. | |
|---|---|---|---|---|
| | Minimum. | Assumed maximum. | Minimum. | Assumed maximum. |
| South Atlantic States—Continued. | | | | |
| West Virginia | 457,000 | 1,261,000 | 381,000 | 1,151,000 |
| North Carolina | 693,000 | 1,050,000 | 578,000 | 875,000 |
| South Carolina | 552,000 | 812,000 | 460,000 | 677,000 |
| Georgia | 449,000 | 752,000 | 374,000 | 627,000 |
| Florida | 9,000 | 16,000 | 8,000 | 13,000 |
| North Central States: | | | | |
| Ohio | 71,000 | 213,000 | 59,000 | 178,000 |
| Indiana | 52,000 | 141,000 | 43,000 | 118,000 |
| Illinois | 230,000 | 414,000 | 192,000 | 345,000 |
| Michigan | 216,000 | 352,000 | 180,000 | 293,000 |
| Wisconsin | 430,000 | 804,000 | 358,000 | 670,000 |
| Minnesota | 278,000 | 593,000 | 232,000 | 494,000 |
| Iowa | 192,000 | 458,000 | 160,000 | 382,000 |
| Missouri | 86,000 | 195,000 | 72,000 | 163,000 |
| North Dakota | 105,000 | 248,000 | 88,000 | 207,000 |
| South Dakota | 51,000 | 90,000 | 43,000 | 75,000 |
| Nebraska | 235,000 | 439,000 | 196,000 | 366,000 |
| Kansas | 130,000 | 323,000 | 111,000 | 269,000 |
| South Central States: | | | | |
| Kentucky | 99,000 | 236,000 | 83,000 | 197,000 |
| Tennessee | 555,000 | 913,000 | 463,000 | 761,000 |
| Alabama | 611,000 | 1,132,000 | 509,000 | 943,000 |
| Mississippi | 38,000 | 75,000 | 32,000 | 63,000 |
| Louisiana | 1,000 | 2,000 | 1,000 | 2,000 |
| Arkansas | 26,000 | 73,000 | 22,000 | 61,000 |
| Oklahoma | 90,000 | 253,000 | 75,000 | 208,000 |
| Texas | 306,000 | 661,000 | 255,000 | 551,000 |
| Western States: | | | | |
| Montana | 3,299,000 | 5,197,000 | 2,749,000 | 4,331,000 |
| Idaho | 1,394,000 | 3,080,000 | 1,162,000 | 2,567,000 |
| Wyoming | 927,000 | 1,566,000 | 773,000 | 1,305,000 |
| Colorado | 1,010,000 | 2,036,000 | 842,000 | 1,697,000 |
| Arizona | 1,071,000 | 2,038,000 | 893,000 | 1,698,000 |
| New Mexico | 192,000 | 527,000 | 160,000 | 439,000 |
| Utah | 892,000 | 1,581,000 | 743,000 | 1,318,000 |
| Nevada | 206,000 | 331,000 | 172,000 | 276,000 |
| Washington | 5,918,000 | 10,376,000 | 4,932,000 | 8,647,000 |
| Oregon | 3,777,000 | 7,935,000 | 3,148,000 | 6,613,000 |
| California | 4,109,000 | 9,382,000 | 3,424,000 | 7,818,000 |

SUMMARY.

| | | | | |
|---|---|---|---|---|
| North Atlantic States | 2,670,000 | 4,910,000 | [1] 2,225,000 | [1] 4,092,000 |
| South Atlantic States | 2,813,000 | 5,107,000 | [1] 2,344,000 | [1] 4,256,000 |
| North Central States | 2,079,000 | 4,270,000 | [1] 1,733,000 | [1] 3,558,000 |
| South Central States | 1,726,000 | 3,342,000 | [1] 1,438,000 | [1] 2,785,000 |
| Western States | 22,795,000 | 44,049,000 | [1] 18,996,000 | [1] 36,707,000 |

[1] This total is arrived at by deducting one-sixth from the total of the 90 per cent efficiency basis; the sum of the items in this column exceeds the total by 7,900 horsepower, due to the fractional gains in making one-sixth reduction for the individual States.

The energy of water which is allowed to flow by unused is irretrievably lost, but the supply neither increases nor decreases by nonuse. Our supply of coal while enormous is not unlimited. Due to economic conditions all over the world the cost of coal, however, is steadily increasing.

In the United States the present per capita annual consumption of coal is 5.5 short tons, or 11,000 pounds. One-fifth of the amount, or 2,200 pounds, is anthracite. The annual rate of consumption will, however, continue to increase unless some greater impetus is given to the development of our water powers.

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### THE WORLD'S SUPPLY OF COAL.

While the exhaustion of the world's coal supply is a long way off, still the price of coal and hence the cost of powers derived from coal will be subject to supply and demand. The latest estimate of the world's coal reserve (C. Engler Zeitschrift fur Angewandte Chemie, 1911, p. 1843) fixes the total at 8,000,000,000,000 tons. Of this quantity 400,000,000,000 tons belongs to Europe and the United States; the remainder is located largely in China. The deposits in Europe and North America are as follows: Germany, 416,000,000,000 tons; Great Britain, 193,000,000,000 tons; Russia, 40,000,000,000 tons; Belgium, 20,000,000,000 tons; France, 190,000,000,000 tons; Austro-Hungary, 17,000,000,000 tons; the United States, 680,000,000,000 tons. At the present rate of consumption the supplies will last as follows: Germany, 3,000 years; Great Britain, 700 years; remainder of Europe, 900 years; United States, 1,700 years.

The power now required to operate the industrial enterprises and public-service utilities of the country (excluding steam railroads and steam pipes) exceeds 30,000,000 horsepower; of this, 6,000,000 horsepower is generated by water. On the assumption that a horsepower by steam can be produced by 3 pounds of coal (which underestimates the average quantity of coal required, under the most favorable conditions a pound of coal can be made to produce 1 horsepower hour), and on a basis of 12-hour power the present water powers of the country save over 33,000,000 tons of coal annually. This is conservation second only in importance to the conservation of human life, which we all hope the present cry of "preparedness" will effect.

The key that will be the "open sesame" to a more general development of water powers throughout this and other countries, which will make possible the dream of a network of power-line distribution from State to State in much the same way that the last century has seen the telegraph, telephone, and railroad net spread over every nook and corner of this great hemisphere, is the improvement in inventions which will make it practicable and economical to carry higher voltages than the maximum of to-day, viz, 150,000 volts, and providing a wider range for distribution than 240 miles to Los Angeles, that of the Big Creek plant in California. There is no doubt that as the demand arises engineers will find the solution of this problem. These improvements will not, however, become available unless and until the Federal and State Governments have formulated a definite legal policy of cooperation which will give a greater impetus to the investment of private capital than present conditions permit.

The investments in water-power enterprises would be very attractive to many people if they felt that there were no franchise limitations which would make the business one of limited duration—like the coal and other mining enterprises—from which as years go by diminishing returns must be expected.

### BIBLIOGRAPHY.

Ontario Hydroelectric Power Commission.

Report United States Board of Engineers on Deep Waterways, 1900.

Message from President of United States, Sixty-second Congress, second session, House of Representatives Document No. 246, 1911.

International Waterways Commission report, Preservation of Niagara Falls, Senate Document No. 105, Sixty-second Congress, first session, 1911.

Electrical World, High Voltage Transmission Lines, April 25, 1914.

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Engineering News, volumes 71, 72.
Engineering Record, volumes 69, 70.
Water Power Development, Prof. Daniel W. Mead.
United States Census, 1910.
Report United States Commissioner of Corporations, 1912, Department of Commerce, "Water Powers of the United States."
Bureau of Census: Central electric light and power stations, street and electric railways, 1912.
The South American Tour, A. S. Peek, page 260. "Around and about South America," Frank Vincent, 1890, pages 186 to 194. "De Buenos Aires al Igazu, M. Bernardez," Buenos Aires, 1901.
Utilization of Atmospheric Nitrogen, Department of Commerce, Dr. Thomas H. Norton, 1912.

The CHAIRMAN. If there is no further business to come before the meeting at this time, we will adjourn.

Thereupon the meeting adjourned at 5.10 o'clock.

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## SESSION OF SUBSECTION 4 OF SECTION III.[1]

RALEIGH HOTEL,
*Wednesday afternoon, December 29, 1915.*

Chairman, SAMUEL FORTIER.

The meeting was called to order at 2.30 o'clock by the chairman.

Papers presented:

Irrigation districts in the United States, by Frank Adams.

Uniformity of distribution of moisture in soils, by P. E. Fuller.

### IRRIGATION DISTRICTS IN THE UNITED STATES.

By FRANK ADAMS,

*Office of Public Roads and Rural Engineering, United States Department of Agriculture, Berkeley, California.*

Barring several earlier special and incomplete irrigation district acts, the district form of irrigation organization has been in use in the western United States since 1887. In that year the Legislature of California embodied in the so-called Wright Act the first comprehensive plan to be adopted in this country authorizing communities to bond and tax themselves for irrigation purposes. For six years following the passage of the Wright law there was great activity in the organization of irrigation districts in California, 49 having been carried through the organization stage during that period, of which, unfortunately, but few of even the worthy ones survived. Within another eight years 6 other Western States enacted laws almost identical with the Wright Act, and during the past 15 years 8 more have placed the general principles of the original Wright Act on their statute books. At this time something over 125 irrigation districts are in operation in the States of Nebraska, New Mexico, Texas, Colorado, Wyoming, Montana, Idaho, Utah, Washington, Oregon, and California, of which the larger number are in Colorado, Idaho, Nebraska, California, and Montana, in the order named. The smallest district operating contains about 500 acres, and the largest about 175,000 acres.

#### NATURE OF AN IRRIGATION DISTRICT.

An irrigation district under the laws of the Western States is an area segregated for irrigation purposes whose boundaries are defined by the county supervisors or commissioners on petition of a certain number of the landowners therein, and whose organization is finally authorized by the affirmative vote of a certain prescribed proportion of the electors possessing certain prescribed qualifications. When duly organized according to law, such a district possesses the right to acquire or construct and operate nec-

[1] There was no stenographic report of this meeting.



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essary irrigation works, including the right of condemnation, and to raise money therefor by the issuance of bonds or the levy of assessments, or both, against the real property embraced. In other words, an irrigation district as understood in the United States is a quasi public municipality having the right to issue bonds and levy assessments for irrigation purposes and to own and operate irrigation works necessary or desirable for the irrigation of the land included within the district boundaries.

The irrigation district laws of the 15 Western States that have authorized this form of irrigation organization differ considerably in detail, and in some cases in principle, more essentially in matters relating to organization, qualifications of electors, issuance of bonds, levying of assessments, and public control. In general it might be said that, although extensive irrigation district development has already occurred, none of the 15 district laws that have been enacted is yet fully settled.

In order to present concretely the essential features of irrigation district organization and management in the Western States the following brief outline of procedure in California is offered, but with the statement that the California law has been further developed than has the law of any of the other Western States:

OUTLINE OF PROCEDURE IN THE ORGANIZATION AND MANAGEMENT OF AN IRRIGATION DISTRICT IN CALIFORNIA.

*Organization.*—(*a*) Petition for organization of district presented to county supervisors by a majority of the landowners in proposed district representing a majority in value of the lands included. Copy of petition filed with State engineer. Lands included in a district must be susceptible to irrigation from a common source or sources, except that towns and cities may be included and be subject to assessment for district purposes.

(*b*) Investigation and report by State engineer. If report of State engineer is adverse, plans must be modified, unless three-fourths of landowners petition supervisors to proceed according to original plan.

(*c*) Final action by supervisors and election on organization. Two-thirds vote required to carry election.

*Construction and issuance of bonds.*—(*a*) Plans and estimates for irrigation works made by a competent irrigation engineer and referred to State engineer.

(*b*) Final determination by board of directors of the district on the plans and estimates and circulation of petition for bond issue, which must be signed by a majority of the owners, representing a majority in value of the lands in district.

(*c*) Election on bond issue. Majority vote required to carry.

(*d*) Investigation and report on bond issue by State engineer, State attorney general, and State superintendent of banks. If their report is favorable, bonds become legal investment for banks, trust and insurance companies, trust and State school funds, etc., and legal security for deposit of public money, etc.

(*e*) Bonds sold and contracts let, or directors proceed with construction. During construction secretary forwards progress reports of work to State engineer.

(*f*) Bonds bear interest not exceeding 6 per cent and are payable from the twenty-first to the fortieth years or earlier. Must be advertised and sold to highest bidder; i. e., can not be exchanged for work.

*Assessments.*—These levied on an ad valorem basis, with improvements exempted. Special assessments for maintenance and operation must be approved by a two-thirds vote of electors, assessments for completion of works by a majority vote. No vote is required on assessments for bond principal and interest or to meet payments due under lease or contract or any obligation reduced to judgment. On default by district officers, county officers act, and in case of their default district attorneys and the attorney general must compel performance.

*Electors.*—Electors under the general election laws of the State may vote at all irrigation district elections.

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*Management.*—This is in the hands of a board of three or five directors chosen at general elections held biennially. An assessor, a collector, and a treasurer are also elected and a secretary is appointed by the board of directors. The directors may be elected by divisions or at large, but must represent separate divisions and reside therein. The directors have full authority to employ engineers, superintendents, and other help and to perform all acts necessary to the conduct of the business of their district, and necessary to the operation and maintenance of the irrigation works, including provision for drainage. They are required to establish equitable rules and regulations for the distribution of the water of the district. Water must be distributed ratably in accordance with assessments paid. A petition of a majority of the landowners in a district, representing a majority in value of the lands included, must be filed with the board of directors before the directors may purchase or lease property for the district costing in excess of $10,000.

### EARLY EXPERIENCES OF IRRIGATION DISTRICTS AND PRESENT STATUS OF IRRIGATION DISTRICT MOVEMENT.

While, as stated above, 14 of the Western States followed California in adopting the irrigation-district principle, early irrigation-district operations in the United States were very unsatisfactory. Of the original 49 California districts, 24 disorganized or were abandoned almost immediately after organization and without any real activity whatever. Of the remaining 25 but 8 are operating in 1915, and of these 8 not more than 5 have attained anything of the success originally contemplated. The original Wright Act proved to be altogether too loosely drawn to prevent unwise and speculative ventures, and when the widespread industrial panic of the early nineties overtook the country, calamity was inevitable. To some extent there had been dishonesty, but to a larger extent failures were due to excessive optimism, inexperience, and incompetence. At any rate, the results under the original Wright Act were such that none of the other States cared to risk a repetition of the California failures and practically no irrigation-district activity was undertaken by them for more than a decade. Even in California new irrigation-district activity ceased entirely for over 10 years.

In the meantime, however, the Wright Act of 1887 was repealed and a revised act passed which corrected the most essential faults and supplied the most essential deficiencies of the former statute. With the experience of California to guide them, most of the other States gradually revised their district laws, and in the decade, 1900–1910, a new start in irrigation-district organization was launched. In this new movement Idaho, Nebraska, and Colorado led. The latter State, however, entirely failed to profit by the earlier experiences of California, and under an altogether inadequate law has within the past decade passed through an experience as disastrous as that of California under the old Wright law of 1887. Of over 50 districts organized in Colorado in the last 10 years but relatively few have proven successful and many never should have been formed. In Idaho, Nebraska, and California, however, irrigation districts organized or reorganized during the same period have almost all been relatively successful, and some have been eminently so. Taking the history of irrigation districts in the United States as a whole, therefore, and with due regard to the failure of unworthy and speculative projects, the measure of success that has been attained by the worthy and feasible farmers' organizations of this character is exceedingly creditable, and in spite of the need for further revising most of the district laws of the Western States the district form of organization is thoroughly established in western North America. In this connection it is interesting to note that the Canadian Provinces of British Columbia and Alberta have within the past two years enacted irrigation district statutes based on those of the 15 Western American States above referred to. It is now even

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proposed to reorganize irrigation projects of the United States Reclamation Service into irrigation districts rather than to continue the special form of water-users' associations that was put into effect when construction under the reclamation act began.

### SOME COMPARISONS OF THE STATE IRRIGATION DISTRICT LAWS.

As already indicated, the irrigation district laws of the various Western States differ quite considerably. It seems desirable to outline briefly some of the more important differences, comment being based on the laws as revised down to 1915:

*Organization.*—The original Wright Act of California was passed in a spirit of revolt against the obstruction of the bonanza landowners and the riparian proprietors of California, and after a long and bitter, and finally a successful, fight to gain control of legislative machinery. As a result majorities of freeholders were given the power to initiate irrigation-district organizations, entirely regardless of whether they owned in the aggregate much or little of the land on which the financial burdens to be incurred would fall. Many districts were organized by majorities of owners in which the property sentiment was overwhelmingly against organization. The real need of the times was a law that would permit development to be undertaken at the instance of a majority of the substantial interests involved, and that would require all landowners, and all of those to be benefited either directly or indirectly, to bear their just burden of that development. Such temperate legislation as that, however, was hardly to be expected under the stress of the day, but when it came to redrafting the Wright Act in the light of an experience extending over a decade the futility of minority rule was recognized. Consequently the California statute was amended to require on the organization petition not a mere majority of the landowners, or less, as formerly but a majority of the landowners representing a majority in value of the lands included. This principle has been accepted in the recently enacted statutes of Texas and British Columbia. In Utah, Montana, New Mexico, and Alberta the majority of owners must represent a majority in acreage, and in Nevada and Idaho it must represent one-fourth of it. Oregon, Washington, Arizona, and Wyoming still require only a majority, with an alternative of 50 in the first-named two. Nebraska and Oklahoma require petitioners to be residents of the State, but not of the proposed district, although they must each own 10 acres in it or hold a five-year leasehold in 40 acres. The Kansas law requires three-fifths of the resident landowners. In Alberta, Canada, owners signing an organization petition must be 21 years of age and be residents within any unirrigated tract in the proposed district or within 5 miles of it. In Colorado the organization petition is sufficient if it contain the signatures of a majority of the landowners, whether resident or nonresident, owning in the aggregate a majority of the area in such district.

If any one fact was fully demonstrated by the early irrigation district failures, it would seem to be the fact that a public investigation of feasibility should precede organization. Still of the 15 Western States of America having irrigation district laws California, Idaho, Wyoming, Nebraska, and Oklahoma stand alone in requiring a preliminary report by the State engineer. British Columbia, Canada, gives to its minister of lands discretionary authority to make a thorough investigation of each proposed district and to report on the feasibility, practicability, and probable cost, and organization must be approved by the board of investigation. Texas requires that feasibility shall be considered by

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the county commissioners court, which is given authority to refuse organization of a district if it would not be feasible or practicable, would not be a public benefit, is not needed, or would not be a public utility.

*Issuance of bonds.*—The earlier provisions regarding the issuance of bonds left the calling of bond elections optional with boards of directors and merely required that they should estimate and determine the amount of money necessary. No provision was made for thorough investigations regarding feasibility or regarding plans and specifications for construction. This absence of any essential prerequisites to the calling of bond elections or the issuance of bonds resulted in gross abuse, and in many cases large bond issues were voted without any clear conception as to where water was to be obtained or as to the character and cost of works necessary to bring it to the land. The amended California act of 1897 assumed to strike at the root of the evil growing out of the former loose practice by providing that not only should a majority of owners, representing a majority in value of the land, be required to propose an irrigation district, but that a petition signed by similar majorities should be submitted before a bond election could be called. Even then, however, the need for adequate engineering investigations was overlooked. When the irrigation district law of Idaho was revised, however, this need was taken into consideration and a provision inserted that all surveys, examinations, maps, plans, and estimates requisite to ascertaining the cost of any proposed construction work should be prepared by a competent irrigation engineer and submitted for report to the State engineer. The practice in this regard first adopted by Idaho is now followed in more or less degree in Oregon, Wyoming, Nebraska, New Mexico, California, and Oklahoma, the last named being the latest to adopt this very desirable amendment. Such a provision was formerly contained in the Nevada law, but has since been eliminated.

California retains the requirement for a petition by a majority of owners representing a majority in value of the lands included; and in Montana a petition is necessary, but it need represent only a majority in acreage rather than a majority in value. In Kansas no preliminary examinations are specified, but a petition is necessary from three-fifths of the resident landowners. In Texas surveys and plans must be made by the engineer of the district and the assessment roll completed and filed before a bond election can be called. In British Columbia the board of investigation must approve plans and estimates. In Arizona after the board has adopted a general plan of operation, an examination and certified report is made by a competent engineer. In Alberta surveys and estimates must be made by a qualified engineer, the assessment roll must be completed, a showing must be made that the proposed works will not cost over $25 per acre or involve an annual maintenance and administration cost exceeding $1.50 per acre, and finally the by-law providing for the loan must be approved by the minister of public works. In Washington, Utah, and Colorado no preliminary investigations are required, and the estimate is made wholly by the board of directors. In Montana no election is held on bond issues, but the plans must be prepared by a competent engineer and the amount of money necessary to be raised determined by the board of directors. The Montana law requires, however, that the signatures to the petition must be verified by affidavit. In Wyoming the holding of a water-right permit from the State engineer is a further requirement.

Absence of adequate control over the disposal of the bonds once voted was a striking feature of the earlier irrigation-district legislation. In California, especially, there was much irregularity, some of it undoubtedly fraudulent, and numerous were the ways that were tried to circumvent the law as construed by

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the courts, some of them both amusing and ingenious. The settled policy came to be that bonds could not be traded for work or sold other than for cash, but there is now considerable variation in the practice followed in the several States. In California bonds must be advertised and sold to the highest bidder, but in practice the bidder has usually, with a few recent notable exceptions, been the contractor's financial backer. The original requirements that bonds should not be sold for less than par has been eliminated by California, but the State now provides for an investigation and report on the physical and financial feasibility of irrigation-district projects and on the water rights held, by the State engineer, the attorney general, and the superintendent of banks. This investigation, although not compulsory, ordinarily precedes the offering of the bonds for sale.

In Oregon, Washington, Utah, Arizona, Colorado, New Mexico, Texas, Idaho, Montana, Wyoming, and British Columbia bonds may be used in the purchase of works or rights or for construction, and in Nevada, Nebraska, and Oklahoma they may be exchanged for works and rights but not for construction. In Nevada, Idaho, Kansas, and Texas bonds must bring par, but in Oregon, Washington, Utah, Arizona, Montana, Wyoming, Nebraska, Colorado, Oklahoma, and New Mexico they can not be sold below limits prescribed by law, which vary from 85 to 95, it being provided in some cases that if exchanged directly for works, water rights, construction, etc., the bonds must go at par. In Texas, court confirmation of the validity of the bonds, a favorable report by the attorney general of the State on their legality, and registration by the comptroller of accounts are all necessary prerequisites. In British Columbia both the form and price of debentures must be approved by the board of investigation, and with the approval of the board of investigation the trustees of districts may mortgage debentures remaining unsold. The trustees of districts in British Columbia are also allowed to use unsold bonds for the payment of any legal indebtedness. The usual interest rate on bonds as specified by the laws is not exceeding 6 per cent. Seven per cent is allowed in Idaho, and in the Canadian Provinces it is enough that it be specified in the by-law covering the issuance.

*Assessments.*—One of the most controverted points in connection with irrigation districts has been the basis of levying assessments. California started with the ad valorem basis, including improvements, but by recent amendment improvements have been eliminated. Nebraska now follows the California law as to both the ad valorem basis and exemption of improvements and Oklahoma has adopted the same provision, and Texas uses the ad valorem basis for collecting the principal and interest of bonds, but provides that for maintenance one-third of the assessments raised shall be prorated on an acreage basis against all land to which water can be furnished, the remaining two-thirds to be paid by the actual water users. Idaho leads in making assessments in accordance with an apportionment of benefits and has been followed in more or less degree by Washington and Nevada. In British Columbia the ad valorem basis is used when benefits are substantially uniform, with improvements exempted, otherwise assessments are levied according to a classification, depending upon benefits.

In Oregon, Utah, Arizona, Montana, Wyoming, Colorado, New Mexico, and Alberta assessments are levied at a uniform rate per acre, with the proviso usually added that no lands shall be assessed that are not irrigable from the source of water adopted.

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IRRIGATION DISTRICT FINANCE.

With the exception of during the earliest years of operation under the original Wright Act and during a brief period in the decade 1900 to 1910, the marketing of irrigation district bonds has always been a serious problem, as it is to-day. Yet, considering the history of irrigation districts in the United States, this can not be considered as surprising. The many mistakes and failures under the original Wright Act left an indelible impression on investors, and the use of the district form of organization in a speculative way in several of the States during the decade 1900 to 1910 created a new feeling of antagonism. This bad history, coupled with the frequent examples of bad management on the part of boards of directors, has seriously handicapped this form of enterprise. The entire West, however, seems now inclined to place irrigation districts on an entirely sound basis. It is now fully realized that the day for irrigation district wildcatting is definitely and finally past; also that for the best results the States themselves must honestly and effectively exercise supervision and control both in the organization of the districts and in their management. Further than this, eastern and many western financiers seem to be insisting that offerings of irrigation-district securities shall be confined to districts that have passed the construction stage and are successfully operating. These financiers take the view that enterprises not yet through the construction stage must be classed as speculative and must be financed by other means than securities offered to the investing public. Only when enterprises are established and no longer speculative, they say, should the public be asked to furnish money at the interest rates common to investment securities.

In some cases it has been proposed either that the States themselves should lend their credit to districts during the construction period, or that construction should be financed on a basis that will allow the usual promoters' profit, leaving the matter of permanent financing to be taken up when success has been attained. It is very clear that those who are guiding irrigation district policies in the West are coming to be in much closer touch than formerly with the eastern financial centers that are called upon to furnish the money, and that we may look forward in the not distant future to such integrity of irrigation district organization as will give to irrigation district securities a standing that the security back of worthy projects fully justifies. Before this condition can be reached, however, it is certain that various States must look carefully to their irrigation district laws and not only provide safeguards against unworthy projects but take such part in the supervision of irrigation districts that the internal management of these farmers' enterprises will be of such a nature as to entitle them to public credit. In addition to these changes, it is not altogether improbable that some form of State aid in financing irrigation districts will be put into effect in some of the more progressive western Commonwealths. Owing to the fact that construction is now far in advance of settlement in irrigation districts as well as on other western projects, however, nothing is likely to be done in the immediate future to stimulate greatly new district development.

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# UNIFORMITY OF DISTRIBUTION OF MOISTURE IN SOILS.[1]

By P. E. FULLER,

*United States Office of Public Roads and Rural Engineering.*

## IMPORTANCE OF IRRIGATION.

It would be amiss to discuss the uniformity of distribution of moisture in soils—the most important function of irrigation—without first treating the economic phase of irrigation.

To the general public the term "irrigation" implies artificial application of water, in some manner or other, to land upon which there is insufficient natural precipitation, and since the arid and semiarid sections of the West are ill furnished with such natural source of moisture, such deficiency must be met by artificial means.

With respect to the United States the time is not far distant when the irrigated sections of the West will contribute a large part of all of the agricultural and horticultural products consumed in the East as well as in the West, but the importance of irrigation throughout the humid sections also, with a view to artificially "filling in," as it were, the seasonal or periodic deficiencies in moisture, caused by occasional or intermittently prolonged droughts, will ultimately be recognized as a means of increasing the dependability of the present agricultural resource.

In the United States we may even now with propriety draw a dividing line along the Missouri River between sections engaged in industrial pursuits on the one hand and agricultural pursuits on the other. The eastern territory, because of its constantly increasing area of depleted soils and its greater proximity to the established world's markets, is becoming more aggressively engaged in the manufacturing industries and their allied pursuits, demanding an ever-expanding territory for factories of all sorts, office buildings, warehouses, transportation facilities, educational institutions, residences, etc., more and more hampering and restricting those engaged in the pastoral pursuits and forcing them gradually to the West, which, with its relatively new soils, rich in mineral plant life, with its greater remoteness from the manufacturing facilities, greater distances from the established markets for manufactured products, and scarcity of labor, is less ideally a manufacturing section; and, further, in a large majority of instances, favored by more prolonged growing seasons and assured crop yields by the artificial application of moisture, the West offers inducements to the industrious farmers as a more suitable field for agricultural pursuits.

As evidence of the startling rate of abandonment of eastern agricultural areas, due alone to soil depletion, Dr. Cyril C. Hopkins, of the University of Illinois, gives, from the United States Bureau of Census statistics, a total of 9,809,834 acres in New England, New York, New Jersey, and Pennsylvania abandoned from 1880 to 1910, and if a similar amount is to be abandoned, it could be so selected as to completely stop farming in eight States, including New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, and either Maine or Florida. In other words, the combined area of improved farm land in these eight States in 1910 was less than 9,809,834 acres.

[1] The Editor—As it was not possible to have prepared the illustrations called for in this paper, the language of reference to these omitted illustrations is that of the editor, who assumes responsibility for the same.

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Irrigation has become an important factor in increasing and retaining the population of a country, the trend of homeseekers from the eastern agricultural areas toward the West being recognized in most all efforts at colonization of irrigation projects; but while the newcomers may be skilled in methods of agriculture as practiced under conditions of natural precipitation, they are apt not to appreciate to the fullest extent the importance of the various factors influencing farming by irrigation, and, while eager to learn the proper methods, in most cases they are left to solve the problem without intelligent advice or assistance, and follow the procedure of their neighbors, with the result that they are led into the same errors.

### MISUSE OF WATER IN IRRIGATION.

From this statement it would appear that those now engaged in farming under irrigation systems are generally open to criticism. In a large majority of instances this is true, and, what is more serious, these pioneers in irrigation seem disinclined to adopt methods differing from those in which their experience has established hard and fast rules.

This is not strange, nor can they be blamed when we consider that the general practice and custom prevailing is the outcome of conditions of irrigation supply existing for many years prior to the establishment of irrigation works whereby regulated supplies are now available, as opposed to the situation prevailing when periodic stream flows were the rule, the undependable nature of which demanded their almost immediate utilization and necessitated attempts at conservation of moisture within the soil during those periods of abundant supply for plant use during lean years or seasons.

This enforced overuse, more than all else, tended to establish the practice of using large heads (or quantity rates of flow), as well as unnecessarily large laterals or distributing ditches for conveyance. It is not, then, difficult to comprehend the natural resentment toward the adoption of principles which may involve deviations from such practice. This natural antipathy, however, is not found to exist in the younger generations, which have had the advantage of collegiate courses in agriculture, or even availed themselves of the opportunities offered in short courses in agriculture by some of our State universities; nor is it found in the inexperienced irrigator who commences this relatively new method of farming, but who, for lack of proper teaching, often falls into the ways of past practice.

Thus the importance of irrigation as a potent factor in the production of crops, which are the very foundation of the world's wealth, should be fully appreciated, and any investigations which may throw additional light upon the subject, tending toward a more intelligent and beneficial use of water, will not only increase the economic duty now considered necessary, but, and more important than all, will conserve the productivity of the land; whereas the present abuses, if continued, will surely sap its productiveness or necessitate the additional burden of drainage, or, if not that, will ultimately ruin the land for future use.

In water duty and moisture determination work conducted by this department in Arizona during the past three years, the following general laws were found to apply: Uniformity of lateral distribution of moisture within a soil can not be attained in a given time without, first, a uniformity of distribution over the surface of the soil. The uniformity in vertical distribution in a given time is dependent upon a uniformly constant absorptive capacity over the entire surface and upon the homogeneity of the soil.

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The depth to which any given quantity of moisture is delivered into a soil in a given time is entirely dependent upon the duration of the application of water to the surface, but the depth of penetration is not directly proportional to the duration of application, except in very open soils, as will be shown later on.

The above modified laws apply when moisture is supplied to soils by irrigation and in which the time is a necessary factor. It is well known that, if sufficient time is allowed, moisture will more or less uniformly distribute itself, due to capillarity, throughout a soil and an equilibrium will be established between this force and that of evaporation.

The rapidity with which moisture moves vertically is dependent upon the time, porosity, effective size of the soil grain, and the physical condition of the soil. It has heretofore been an accepted idea that capillarity is independent of the force of gravity, but this office has, through many tests, proven that the force of gravity influences capillarity in all soils but more in the coarse than in the compact ones.

The rate of absorption of moisture by soil in surface contact with water is dependent upon its physical condition as regards compactness, its structure, and the crop to which it is planted.

The idea generally prevailing among irrigators is to flood the land by the flowing of water over areas of given width and length, the duration of application (often referred to as the "time of application") being governed by one or more factors, such as "the time necessary to give it a good wetting"; "until the water does not readily disappear at the lower end of the land"; "for an interval of time based upon past use to obtain a given crop yield"; "the number of hours during which a given head for the entire area is allotted by the zanjero"; sometimes, but rarely, governed by "intelligent comprehension of crop requirements"; and, not infrequently, "during a time which will not allow the overflow of excess water upon the public highways."

However strange it may seem, cognizance is seldom taken of the soil type or its condition to receive water, nor is it the aim to obtain uniform penetration of a sufficient amount of moisture to supply the net plant duty and to compensate for evaporation. The writer recalls no instance where the soil auger forms a part of the farm equipment, notwithstanding it should be the most valuable adjunct thereto. The nearest approach to this is the crude practice of inserting a shovel handle into the soil to determine whether it has had a "good wetting" or not.

The frequency of application is usually established by custom, whereby a run of water is had at intervals of each 10 or 15 days or longer during the growing season, or it may be influenced by physical evidence of plant need in some sections of the field, thereby again un-uniformly applying moisture to all parts alike. In some instances application is withheld during the hot summer months, while in other cases winter irrigation is practiced.

The gradient of land receives no serious consideration more than that it is a recognized necessity in irrigation and a detriment when excessive. In several instances which have come under my observation the arrangement of certain tracts of land have been changed three times with a view to striking a gradient which would enable the irrigator to get the water over the bordered strips within a reasonable time. In these cases the irrigator has not only wasted water and labor in endeavoring to cover all parts of his field but has lost a large part of the crop by failing to uniformly apply water.

The above variance in practice explains the variable result obtained in crop yield upon similar lands under the use of similar quantities of water and the cause of the waste heretofore mentioned.

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SUGGESTION OF PLAN FOR BETTERING IRRIGATION PRACTICE.

In this regard I believe it would return the expense many fold if each State were to establish a bureau, the purpose of which would be to carefully study the surface and subsoil structures and water transmission or absorption capacities with respect to gradients and crops raised under the existing climatological conditions affecting each tract of land under an irrigation project, thereby rendering to the individual farmer the benefit of exact scientific knowledge as to the most economical method of applying irrigation water, the best arrangement of each individual tract of land to so receive water, the proper duration of application, and the quantity rate of flow necessary to obtain the best results.

If the duty of water were adjudicated upon such a basis, not only would given irrigation supplies be available for larger areas than is possible under the present methods of adjudication, involving, as they generally do, an analysis of past uses based upon average conditions existing in an entire locality, but the ultimate ruination of land by water-logging and alkalying (an inevitable result of water-logging), as well as the washing out of plant foods in porous soils, would, in the majority of instances, be precluded.

The irrigation investigations branch of the Office of Public Roads and Rural Engineering by both practical demonstration and scientific publications has been and is doing much to mitigate the evils resulting from overuse of water in irrigation; but the field for such endeavor is so vast and the funds available heretofore so limited, that much time will be required before aid can be rendered which will show individual benefit. Our efforts, however, could be furthered and results expedited by a general recognition by the judiciary of the evils which will inevitably result from such abuse in the use of water and readjudication of water duties by it as rapidly as such studies revealed the need.

Obviously such a method of adjudication would of necessity establish duties varying with the different soil types comprising a project, but this method is perfectly practicable and must at some future time be resorted to if anywhere near the total area of arable land is to be irrigated with the limited water supplies available in the Western States.

It has been frequently assumed that the delivery of water upon a metered basis would tend to increase the duty now believed necessary, and, while this would no doubt aid in a more economic use of water, I believe the end sought would best be effected by the imparting of scientific knowledge to the irrigator, combined with actual demonstration of the possibilities of saving and the enforcement of compulsory minimum use.

CONVEYANCE LOSS.

At this point, before treating upon the text of this paper, I should feel that the subject were slighted did I not emphasize another feature having to do with conservation—namely, that of "Conveyance loss."

While this feature has largely to do with administration a saving in conveyance loss may lessen the initial project cost per acre to landowners by expanding the area possible to irrigate, and while having no ultimate effect upon land productivity it reduces maintenance cost and adds to the taxable wealth of a community by adding productive area.

Mr. Samuel Fortier, chief of irrigation investigations of the Office of Public Roads and Rural Engineering of the Department of Agriculture, draws an interesting comparison between the tolerable losses in hydroelectric power generation and transmission systems as compared with those of canal-convey-

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ing systems. He states that "after all loses in the former are taken into account the efficiency of water for power is double that for irrigation."[1]

The testimony of engineers before the congressional committee[2] placed the seepage and evaporation loss in conveying water from the Granite Reef Dam, under the Salt River Valley (Arizona) project, a distance of 20 miles, at from 27½ to 32½ per cent, of which the evaporation loss was 2½ per cent.

The flow from this canal irrigates approximately 100,000 acres. A saving of 25 per cent in this instance would add to the cultivated area some 25,000 acres (value at least $3,000,000), at an expenditure of probably not to exceed $1,500,000 for the concrete lining of the entire 20 miles of canal.

This applies to but one of the main canals, whereas the report of the survey board[3] for limiting the area of land to be served by that project states that a gross duty at the diversion heading of 5 acre-feet results in a net duty at the land of 3.5 acre-feet; thus a loss of 30 per cent is sustained for the entire project, involving a little over 180,000 acres.

The cost of canal cleaning is a large factor in the maintenance of irrigation systems, but another evil, not assessed as a maintenance charge, is the affording of breeding places for pernicious weeds, the seeds of which ultimately find seat upon the land and infest it with growths which detract from the value of the crop yields and necessitate continuous expenditure for their eradication.

It seems inconsistent with good engineering practice to thoroughly exploit the feasibility of constructing expensive controlling works without giving due consideration to methods of conserving the water supply during its conveyance, yet it is seldom that lined canals are considered necessary at the time a project is instigated, and usually the importance is not even appreciated later on. Such procedure is as absurd as the construction of a highly efficient power-generating plant and the use of iron wire, with its characteristic inefficiency as compared with copper, for transmitting the power.

One of the basic principles upon which water rights are adjudicated is beneficial use. Therefore any waste is inimical to beneficial use; hence should not be tolerated.

### EFFECT OF WASTE UPON LAND.

I have mentioned the evil effect which may result from overuse of water by water-logging. It is, of course, not to be inferred that all land will thus become ruined, but such soils as escape this effect are either porous or are underlain with porous subsoil which permits of almost unlimited application of water, yet conveys the excess vertically to the plane of ground-water accumulation, to then move off laterally at a rate dependent upon the ground-water gradient and the frictional coefficient of the deeper soil.

This slow lateral movement of seepage water (usually not exceeding 8 to 10 feet per year[4]) may, if the course is not of uniform transmission capacity, build up the ground-water level beneath land lying below the point of application, thus ultimately affecting that land deleteriously. Or, if the ground water beneath such soil has not a sufficiently high transmission capacity, the water plane beneath the land may gradually be built up until its effect is quite the same as would obtain in a closer soil, notwithstanding the depth at which the

[1] Address of Samuel Fortier on "Duty of Water in Irrigation" before International Engineering Congress, San Francisco, 1915.

[2] Report of Congressional Committee for investigating the cost of the Salt River Valley (Arizona) project.

[3] Report of Survey Board, dated Dec. 9, 1913, relative to delimiting area to be irrigated under the Salt River Valley (Arizona) project.

[4] See investigations by Carpenter, Schlicter, and the writer.

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water plane occurred, at the inception of irrigation practice, were 25 or more feet below the ground surface.

I have in mind such an instance in Arizona, where, due in part to the application of excessive quantities of water under an unregulated supply (now continued to a less dangerous extent), and in part to irrigation of lands lying above the area in question, the water plane has risen 10 to 20 feet in the past 12 years and some 9,000 acres of this irrigated area must now be drained, since the water plane has risen to a depth of within a few feet of the surface level and the land is heavily impregnated with sodium sulphate and carbonate.

In the State of Texas, exclusive of the rice fields, there are some 800,000 acres irrigated. In one section 20,000 acres are now water-logged to such an extent that the yield is but 50 per cent of its former amount, and this affected area will very soon have increased to 40,000 or 50,000 acres or between 40 and 50 per cent of the entire irrigated area. In another district, comprising 15,000 acres, 90 per cent has become water-logged and drainage is being resorted to. Yet another section shows 15 to 20 per cent now requiring drainage. It is estimated by Mr. Rockwell, of this office, that in other sections no less than 10 per cent is so affected.

In Utah, one of the oldest irrigated States, there are between 1,200,000 and 1,500,000 acres under irrigation, of which Mr. Hart, of the United States drainage department, estimates 250,000 acres are at present water-logged, requiring drainage.

Nevada reports 750,000 acres now irrigated, and 250,000 contemplated, with about 5 per cent now requiring drainage, and the State engineer states that, with continued irrigation, this percentage will increase very rapidly.

Idaho has 1,647,430 acres under cultivation out of 3,153,512 under irrigation systems, but the exact area water-logged was not known, the report showing 8,000 acres in one section and drainage works under construction in other sections to care for the water-logged districts.

Arizona has closely 350,000 acres, of which about 50 per cent is under the Roosevelt project. Out of 21,200 acres in the heart of the irrigation district (without a regulated supply, not having subscribed to the project) over 9,400 acres require drainage and a system is now projected therefor. Water-logged areas under the reservoir project are showing up in scattered sections, but not, as yet, to an alarming extent.

In Colorado, the greatest irrigated State in the Union, out of 6,000,000 acres under projects there are 3,000,000 acres now irrigated, 750,000 acres of which now need drainage.

In the State of New Mexico, out of 797,342 acres now irrigated 120,000 acres are now water-logged and will require drainage.

California has large areas in and about the Fresno, Modesto, and Turlock districts as well as in other sections, but there are few instances of soil becoming water-logged from water applied by individual pumping plants, as is exemplified in Kansas where the largest part of 40,000 acres, according to H. B. Walker,[1] is irrigated under pumping plants and the area requiring drainage, due to wasteful use of water, is less than one-tenth of 1 per cent. This is a significant fact, which shows that small heads of water, which usually prevail in pumping plants, together with the relatively higher cost of such water, compels a more careful application and less wasteful use.

It was not possible to obtain data upon this important matter from all of the States where irrigation is practiced, but those mentioned will serve to show the

[1] Drainage and Irrigation Engineer, Kansas State Agricultural College, Manhattan, Kans.

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prevalency of the evil, and while the percentage is not at present generally large, irrigation has not been practiced over a very extended period, averaging probably considerably less than 20 years, and in some instances but a few years, but has served to increase the water-logged area to an alarming extent.

It has been inferred, and in some instances believed, that this condition is a necessary consequence of irrigation. Such, however, is not the case. Any soil, planted to any crop, may be properly irrigated so as to provide the necessary plant moisture, yet not permit a waste of water below the root zone. Such quantity of water as will meet the actual plant requirements is considered the maximum duty. To this duty must be added water necessary to make up for surface evaporation; but this, too, may be minimized by mulching of the surface soil when the nature of the crop grown permits.

### WATER DUTY.

The duty of water upon land signifies the quantity applied. Gross duty usually indicates the quantity delivered at a diversion heading or at a reservoir outlet, that quantity actually reaching the land being considered the net duty. Economic duty signifies the minimum quantity which returns the maximum yield. For example: It is quantity which, if increased, does not produce a proportionate increase in yield. The maximum duty is regarded as the quantity of water necessary for actual plant growth.

Duty may be stated in many ways, the strict engineering interpretation being the amount of land which 1 second-foot of water will irrigate to a depth necessary to produce a given crop, when flowing continuously during an irrigation season. A more common use of the word, as now generally accepted, is simply the depth of water, as 1 acre-foot or 12 acre-inches.

The Department of Agriculture[1] has made a very careful study of the extent of this maximum duty for various crops, and an application of the information available therefrom should prove of great value in ascertaining whether an excess of water is being applied in any instance of crop production under irrigation.

Following is the maximum duty for alfalfa as determined in the above investigations:

| Tons per acre. | Duty to meet plant requirements. |
|---|---|
| | *Acre-feet.* |
| 4 | 2.442 |
| 6 | 3.663 |
| 8 | 4.884 |
| 10 | 6.1050 |

To the foregoing maximum duties, of course, must be added a depth to compensate for evaporation, deducting the natural rainfall.

### EXAMPLES OF WASTEFUL AND ECONOMIC USE OF WATER.

Of a number of tracts of land in the Salt River Valley, Ariz., upon which the duty of water has been investigated by this department during the past three years, I have chosen two for the purpose of illustrating, first, the

[1] See Journal of Agricultural Research, Vol. III, No. 1, on "Relative requirements of plants," Briggs and Shantz.

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waste due to overuse of water in porous soils, and, second, the results possible to attain with close soils and an economic use of water. These data are as follows:

| Tract. | Soil type. | Yields per acre. | Depth applied. | Net applied for plant.[1] | Maximum duty.[2] | Porosity of soils. | Waste. |
|---|---|---|---|---|---|---|---|
| | | *Tons.* | *Acre-feet.* | *Acre-feet.* | *Acre-feet.* | *Per cent.* | *Per cent.* |
| A. Wasteful use..... | Silt, sand, and gravel. | 5 | 6 | 5.89 | 3.05 | 20.2 | 48.2 |
| B. Economical use... | Sandy clay..... | 6.99 | 5.09 | 4.12 | 4.26 | 23.6 | 3.40 gain |

[1] Corrected for rainfall and evaporation. [2] As determined by Briggs and Shantz.

In adding rainfall, in column headed "Net applied for plant," for the purpose of determining the net, only such precipitation as amounted to over 0.6 inches was considered. Evaporation was that found by evaporimeter.

| | Distribution of moisture in soil. | | | | | |
|---|---|---|---|---|---|---|
| | 0 to 1 foot. | 1 to 2 feet. | 2 to 3 feet. | 3 to 4 feet. | 4 to 5 feet. | 5 to 6 feet. |
| Tract A: | | | | | | |
| Head..... | 16.2 | 16.3 | 12.4 | 12.2 | 18.0 | 18.7 |
| Center..... | 17.6 | 15.7 | 14.4 | 14.0 | 16.9 | 20.0 |
| End..... | 19.0 | 15.2 | 16.0 | 15.2 | 15.7 | 21.2 |
| Tract B: | | | | | | |
| Head..... | 14.4 | 14.8 | 10.7 | 8.0 | 8.1 | 10.6 |
| Center..... | 13.2 | 15.4 | 13.2 | 12.2 | 12.2 | 13.8 |
| End..... | 13.8 | 14.7 | 13.6 | 10.0 | 9.0 | 10.7 |

Tract A, in the above tabulations, upon which water was wasted, is situated at the margin of the water-logged area mentioned and is contributing to the rising water plane. The soil is loose and porous, while tract B is a sandy clay formation.

Attention is called to the generally higher percentages of moisture found at the end of tract A as compared with the center and head of the same tract, showing an ununiform application.

It will also be noted that the vertical distribution is very ununiform, being relatively very high at the lower depths and increasing as the water plane is approached. Quite the opposite condition is found to exist in the soil comprising tract B. The cause of such ununiform distribution and its remedy will be discussed later on.

### UNIFORM DISTRIBUTION OF WATER.

Natural precipitation by rainfall or snow provides uniform distribution of moisture in soils of homogeneous structure, because of a uniform surface distribution, and the adoption of any artificial means whereby such uniform surface distribution or application can be duplicated must necessarily provide this ideal condition.

Obviously, if water can be applied at the same moment, at the same rate, and during the same period of duration over each square foot of land, then, assuming a constant soil type, the moisture will be applied uniformly and will proceed downward at a uniform rate and, unless the rate of application be in excess of the capillary attraction and force of gravity, thereby permitting run-off, the efficiency of the irrigation method will be 100 per cent.

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It is well known that sprinkling systems approach this ideal more than any means of artificial application, but their cost is such as to be prohibitive except for small areas planted to very profitable crops.

The next nearest approach to results attained by natural precipitation or by sprinkling systems is accomplished by dividing the land into many small areas or furrows bordered at the higher end with small ditches, whereby water may be turned into each small plot individually, in relatively large heads, for a short period of time or until the necessary quantity of water has been applied. While this plan is not regarded as feasible or practicable upon large areas, excepting with furrows (which will be discussed later on), because of the obstruction offered to farm machinery and the greater expense of irrigation, yet, nevertheless, it is closely approached in irrigating by pumping plants where the head is usually small.

The more common practice upon large areas, when heads of from 10 to 20 cubic feet per second are available, is that of flooding strips of land between borders, the strips varying in width from 10 to 50 feet and in lengths from 400 to 2,640 feet, or even more. In some instances checks are created at points along the strips of land confined between these borders, extending almost across the entire strip, for the purpose of retarding the flow or to deflect the water from one side to the other. Frequently these checks extend entirely across the strip and form basins which are allowed to fill to a uniform depth, when the check is then broken and the excess water allowed to flow into the next lower check, and so on.

In any of these systems it is obvious that the water must remain in contact with the land at the inlet end a greater time than at the next adjoining area, etc., until at the lower end the duration of contact must be less than at any preceding point.

Attempts are usually made to compensate for these differences in time of application by discontinuing the flow at the inlet end when the front of the approaching stream has reached one-half, one-third, or three-quarters the length of the strip.

Even theoretically such methods, while giving approximate results, can not produce uniform distribution unless the soil type were to change to a coarser formation, each foot of advance to compensate the time difference in application.

Obviously, by this method, the gradient determines the head necessary to employ or the length of the strip of land possible to flood, each usually being regarded as equal functions of the time required for the water to move from the inlet end to the extreme lower end of the land. Therefore, to obtain the delivery of a given quantity of water into the soil by such methods, it would be necessary to apply it during such time as was required for the water to advance the length of the strip; then, after this water had become absorbed, again admit water in the same manner, repeating the operation until the desired quantity had penetrated the soil. This method will give a fairly uniform vertical and lateral penetration and is in use by some of the more successful irrigators in the Lehi section of Arizona, where a very compact adobe soil, theretofore regarded unproductive, is now successfully producing alfalfa.

In very open, porous soils the necessity of short borders or unusually large heads is often recognized, but the water is allowed to continue in its flow, without interruption, irrespective of the resulting ununiform penetration, depending upon a large head to "push" the water to the lower end of long lands.

To obtain a theoretically ideal uniform penetration of moisture by methods of flooding would require a supply advancing with the water front as it

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approaches the lower end of the land strip, thereby providing just the amount of moisture that the soil could absorb as the flow advanced, repeating the operation as often as necessary to obtain the required uniform depth of penetration.

Unfortunately, however, this method is impracticable and, in lieu thereof, we must depend upon the application of the entire quantity at the inlet end, allowing it to advance and spread over the entire area.

As an illustration of the application of water by the flooding method, imagine, if you will, a large snowball at the inlet end of a strip of land, which were allowed to roll, due to the slope, over the land, leaving a uniform film of snow (the converse of our boyhood experience in rolling large snowballs). The rate at which the ball moves, in this illustration, would depend upon the slope of the land, whilst the thickness of the film would, if it were water, depend upon the absorptive capacity of the soil and its homogeneity.

Such a condition is analogous to a theoretically ideal application of water to land. However, the actual methods used in applying water are analagous to our holding this ball at the inlet end and drawing the sheet of snow over the land as the ball is unwound, as it were. Fortunately, in close, compact soils, due to the relatively slow rate of absorption, the continuous supply at the inlet end will give a fairly uniform lateral and vertical distribution in the soil; but, with porous soils, this is impossible without an excessive waste extending from the inlet end to possibly one-half the length of the strip of land.

Now, since these two types of soil—the close and the porous—are invariably found under all projects and each type demands the same uniform distribution of moisture, a method of application involving the same general practice must be adopted.

To obtain uniform vertical distribution of moisture under irrigation by the furrow method is not so difficult, for two reasons: As a rule the soil is plowed to depths not infrequently as great as the depth of the furrow; hence the interstices in the top soil, on either side of the furrow, encourage a rapid lateral penetration which is quite uniform, and the moisture accumulated therein may then slowly, by capillarity, move vertically into the more compact subsoil beneath this wetted area; or it is a simple matter to intersect a furrow system at numerous points by ditch laterals, thus varying the length of furrow to meet the need of uniform vertical penetration.

Plate 2[1] illustrates an ideal uniformity of lateral penetration by the furrow method where the furrows are 2,640 feet long, the head used one-eighth of a cubic foot per second, and the total period of application 22 hours. The land here illustrated showed the following percentages of moisture at the depths given.

| Depth below surface. | Per cent of moisture. | | |
|---|---|---|---|
| | At inlet or head end of furrow. | Midway between head and end of furrow. | End of furrow. |
| *Feet.* | | | |
| 0–1 | 9.6 | 10.0 | 9.4 |
| 1–2 | 14.8 | 14.7 | 10.2 |
| 2–3 | 17.7 | 16.2 | 10.2 |
| 3–4 | 13.2 | 13.7 | 12.6 |
| Mean | 13.8 | 13.8 | 10.6 |

[1] Shown as stereopticon slide.

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It will be noted that the vertical distribution of moisture in this land is uniform to some point beyond 1,320 feet and is not far from ideal throughout the entire length. This soil was sandy clay, rather tight.

As opposed to the excellent results obtained in this tract we may observe the performance of furrow irrigation in a loose, sandy loam soil, with furrows 1,000 feet long, irrigated with the same head during the same period of time:

| Depth below surface. | Per cent of moisture. | | |
|---|---|---|---|
| | At inlet or head end of furrow. | Midway between head and end of furrow. | End of furrow. |
| *Feet.* | | | |
| 0–1 | 16.6 | 15.8 | 12.6 |
| 1–2 | 16.0 | 13.3 | 4.6 |
| 2–3 | 17.6 | 15.4 | 4.5 |
| 3–4 | 18.7 | 9.9 | 4.2 |
| 4–5 | 16.6 | 15.6 | 4.6 |
| 5–6 | 16.8 | 15.5 | 4.8 |
| Mean | 17.05 | 14.25 | 5.9 |

Here it will be noted that uniform vertical distribution extended only between 200 and 300 feet. Obviously the furrows in the latter instance should have been much shorter to have secured a uniform vertical distribution. This could have been effected by the plowing of temporary laterals intercepting the furrows at two additional places and supplying the water at three points instead of at one.

In this connection, the system employed in the Hawaiian Islands[1] seems ideal, in that short furrows from 35 to 45 feet long are employed, which run upon a flat gradient, the natural land slope being utilized for the lateral ditches, which not infrequently feed these short furrows at both ends. In fact, the latter method of feeding is preferred. This system is highly commendable for loose soils where furrow irrigation is employed, and, by connecting a number of furrows in this manner with numerous laterals, large heads may be used and thus simultaneous applications to large areas obtained.

The furrow system of irrigation is also extensively used for the irrigation of trees and vitacultural crops, but somewhat different results are sought in such instances, particularly with trees, in that the aim should be, during the early growth of a tree, to secure a lateral development of the root system, thereafter forcing a deeper root penetration by distributing the moisture to greater depths.

With a view to demonstrating what could be accomplished by a systematic and proper distribution of moisture in soils planted to deciduous fruit trees, an orchard comprising two acres was established upon an experimental tract near Higley, Ariz.

During the first year (1911) furrows for irrigating were arranged so that water encircled each tree, while during the second year the furrow was in the form of a "C" around each tree, water being allowed to back up therein until the desired penetration of moisture was obtained. During the third and subsequent year a double "C" furrow with a short branch was used.

It was found, after observation, that the moisture content at a depth of 30 inches should not be less than 5 per cent; hence the moisture was not, at any

[1] See bulletin by this office on "Irrigation in Hawaii."



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time, allowed to become less than that amount at this depth, the average maximum being 10.39 per cent. The same minimum allowable percentage was adopted for subsequent years, but the depth at which this minimum was retained was increased to 48 inches.

I have prepared some interesting curve graphs to illustrate the manner in which the moisture distributed itself under differing periods of water application, but the conclusions merely will be given in this paper.

One of these curves shows the annual duty from the inception of planting up until December 10, 1915. Others represent the tree growth of two varieties of peach. The ordinate values are the results found by calipering the trunk of the tree each year at similar points and squaring these diameter in inches.

Another curve represents rainfall duty, which was beneficial to tree growth only, it having been found that precipitations of less than 0.6 inch in 48 hours did not penetrate the 5-inch soil mulch. The relative decrease in artificial moisture during 1915 was due to the abnormal precipitation.

All of the trees in this orchard are in full bloom and bearing bountifully, notwithstanding the remarkable duty of 1.42 acre-feet during the past year, which is one-half the quantity considered necessary for similar trees in this section of Arizona.

The furrow method of irrigation for trees, especially if planted in a close soil, possessses advantages over the flooding system if proper duration of application be maintained, as the zone of maximum moisture content occurs beneath the tree, extending vertically to the greatest desired depth and laterally a sufficient distance to provide ample area for plant sustenance, whereas the flooding method for such tree crops may fail to give the proper depth of penetration, thus developing a root system close to the surface, which early suffers for want of moisture due to rapid evaporation of that moisture from shallow depths.

The duration of application of water is the essential requirement in irrigation of trees by furrow methods. Not large quantities but small quantities applied during long periods of time, if the soil be of a close nature, will give the highest economy in water use.

Several orchards in close proximity to this experimental tract have been killed by improper distribution of soil moisture, notwithstanding large quantities were applied by the usual flooding method. In one instance (that of the Locke almond orchard) the practice of disking the soil to shallow depths was followed, but the duration of the application of water was not such as to secure deep, uniform penetration, and after a few years of profitable production a majority of the trees died. Examination of the root system showed the development to have been almost wholly within 12 inches of the surface, where the influence of the sun's heat and rapid evaporation could not be compensated by the relatively small quantity of moisture available in the shallow saturated soil.

Such conditions do not, of course, exist in open, porous soils; but the evils resulting from flooding in such soils is in the form of water waste and ununiformity of distribution. There is, of course, a possibility of waste, even with the furrow method, in open soils, but not so great as in the flooding method. With the furrow method, as with the flooding method, or basin, check, or terrace systems, it becomes an imperative necessity to know where the moisture goes, how deep it penetrates, and the amount that enters the soil, and, while established rules may be laid down for the irrigation of different crops planted in varying soils, which will serve far more satisfactorily in securing more uniform results with less waste, some means of measuring moisture must be employed if the best results are to be derived from artificial application of moisture to soils.

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DISTRIBUTION OF MOISTURE BY THE BORDER SYSTEM OF IRRIGATION.

The greatest difficulty is experienced in securing uniformity and depth of penetration under the border systems, yet, because of its advantages (low cost of land preparation, simplicity of land arrangement, absence of obstruction to farm machinery, and less waste of land), it is more generally used than any other. Its use in the irrigation of alfalfa and other forage crops is almost universal, and grain crops are also very generally irrigated by this system.

The use of the soil auger, both before and after application, is essential to a proper irrigation of land by the flooding method. Soil moisture determinations should be made at regular intervals between periods of irrigation, until each tract of land is rated, as it were, for the different crop conditions, after which it will be found a simple matter to apply irrigation water to a highly economical degree.

With a view to showing the method of interrupting the movement of soil moisture in a close soil, I present herewith a moisture diagram and the result of such a study of one of the fields under investigation in Arizona.

The field in question is owned by Mr. A. Berkenkamp and is situated directly east of Mesa, Ariz. The length of the land strips is 900 feet and the width between borders 49.5 feet. The head used was 400 Arizona miner's inches (10 cubic feet per second), and four strips or borders were irrigated simultaneously. The slope of the land in each strip is 3 feet or 17.598 feet per mile. The duration of application was from 2 to 3 hours (for each four strips simultaneously irrigated), depending upon soil conditions. The duration of irrigation was 157 minutes. The average duty of water was 4 acre-feet, and the average yield per acre for the season 6.60 tons. The maximum depth of root zones was 6 feet.

A moisture diagram would illustrate graphically the action of the moisture in the soil at varied intervals of time after application as well as the condtion of the soil before irrigation.

Such diagrams afford excellent means of studying soil moisture conditions and should be obtained for each field as often as necessary to rate the field.

For instance, it has been found that the wilting point for alfalfa in this soil is 5 per cent average. Moisture determinations were taken August 5, 1915. The moisture content to the 1-foot depth is found to be 3 per cent, increasing to 6.2 per cent at 2 feet in depth and varying from that to 5.1 per cent at a depth of 6 feet. When only 5 per cent of moisture (as determined by a mean of this curve) is found in the soil, the plant is suffering from want of moisture. A better limit to adopt is 10 per cent above wilting, or 5.5 per cent of moisture.

The diagram prepared by me shows that irrigation was applied August 6, when that danger point was reached, one curve showing the extent and vertical distribution of the moisture. While the percentage of moisture content is not absolutely uniform, it varies between 10.4 and 12.5 per cent down to a depth of 5 feet, thereafter tapering off to 5.1 per cent at the 6-foot depth. If loss by seepage had occurred below the 5-foot depth, it would have been evidenced by the gradient sloping in the opposite direction, or else by its continuing as a straight line below the 5-foot depth to a depth beyond the root zone of the plants grown in the field. As it is, however, it shows an ideal tapering off of the vertical penetration of moisture to the natural 5.1 per cent soil content at the 6-foot depth. The average of this application curve is shown to be 10.7 per cent. This result was obtained after a duration of application of 157 minutes and a total depth of application of 0.53 acre-foot.

On August 13 but little moisture had been used in supplying plant life excepting at a depth of from 4 to 5 feet, the greatest consumption being at the 5-

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foot depth, where the lower roots occurred and which evidently began the use of moisture first. The return of water from the soil to supply evaporation to a depth of 1 foot below the surface was very rapid, gradually decreasing, however, to the 2-foot depth.

Again on August 23 soil moisture determinations gave an average moisture content of 8.35 per cent. Here evaporation had reduced the percentage in the first foot to 5.1 per cent, its influence decreasing from there down until 10 per cent remained at the 2-foot depth, thence maintaining this average to the 4-foot depth, but the plant had drawn upon the moisture content from the 4-foot depth to the 6-foot depth at a more rapid rate.

In my diagram the black hatched area between curve B and curve C represents a reservoir of moisture, upon which the plant and evaporation could draw, if necessary, until the safe wilting point had been reached, but it would be better practice to again supply moisture by irrigation when curve C has been reached in moisture content (which is shown in the diagram to be at intervals of 17 days), unless this condition occurs during the extremely hot summer months, when it is desirable to withhold irrigation or it is contemplated making a seed crop, and the accumulated moisture shown in the hatched area may be utilized to the safe wilting curve B. This limit in any particular soil would, of course, be determined by preparing similar diagrams covering conditions of crop, time of cutting, etc.

While the evaporation rate will in all instances vary somewhat during the season, it is not a controlling factor in supplying plant need and may be regarded as subservient to plant needs.

The total moisture in the soil of a given field expressed in acre-feet and available for plant need and evaporation between the safe wilting curve B and any other curve may be quickly computed for the entire depth or for any section of depth by the following formula:

$$\text{Acre-feet} = \frac{w\,a\,d\,(p - p_1)}{[100 - (p - p_1)]\,(62.5 \times 43{,}560)}$$

Where w=dry weight in pounds of 1 cubic foot of the average earth throughout depth d.
a=area of field considered in square feet.
d=depth from surface to point in which moisture is measured.
p=per cent moisture average, shown by curve of moisture limits.
$p_1$=per cent moisture average in safe wilting curve.
62.5=weight of 1 cubic foot of water.
43,560=square feet per acre.

The total quantity in acre-feet, if divided by the area in square feet, will, of course, give the equivalent depth over the entire area, if such an equivalent is desired.

This upon the 1.023 acres in the plot under study, would show very closely 0.22 acre-foot, or a maximum duty for nearly 0.37 of a ton per acre as a safety margin to draw upon, if necessary, between the 8.35 per cent curve and the safe wilting 5.5 per cent moisture curve to a depth of 5 feet.

The average irrigation moisture curve, taken as 10.7 per cent, would show a total content to the safe wilting curve, in a depth of 6 feet, amounting, from the preceding formula, to 0.517 acre-foot, or a maximum duty if applied each 17 days during an irrigation season of 8 months, of 7.24 acre-feet, capable of producing nearly 12 tons per acre for a season of 8 months.

Of course a certain percentage of this moisture is lost to evaporation; hence the actual maximum duty for plant sustenance is somewhat below that amount. The amount of moisture lost to evaporation during intervals of application may

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be ascertained from such a curve or it may be determined for the period intervening between moisture determinations, provided, of course, the amount of moisture applied to the soil and that present before application be known.

In the instance under consideration the evaporation was found by an 18-inch evaporimeter to be closely 35 inches during 11 months and from a 9-inch evaporimeter closely 48 inches during the same period. However, evaporation being variable and depending upon the depth at which the larger percentages of moisture occur, if such data is required with accuracy, it can better be obtained by evaporimeters located in the alfalfa field under physical conditions obtaining.

I am of the opinion, however, that data with respect to evaporation, beyond serving as an index in determining the maximum duty in relation to the Briggs & Shantz method, is really unnecessary in a study of this nature, the curves giving all the information it is necessary to have to apply water in an economical manner, unless evaporation can be greatly retarded by cultivation, which is hardly practical with crops of the class under consideration.

Another curve graph is used to indicate an abnormal moisture content, due to a natural precipitation occurring shortly after an application of moisture by irrigation. This shows an average moisture content of 14.5 per cent and is very interesting in that it shows a loss due to percolation beyond the root zone.

The natural conclusion from this curve would be that this soil should not be irrigated to the 14.5 per cent moisture content, as this quantity is more than can be retained without deep percolation loss.

For the purpose of illustrating waste in the application of water upon open, porous soils I have prepared a second moisture diagram.

One curve indicates that 15.9 per cent moisture was supplied to the soil during irrigation, but a part of the moisture escaped below the 6-foot depth, as indicated by the dotted continuation of this curve. This tract of land is situated upon a margin of the flooded area heretofore mentioned, and the overuse of water is tending to build up the water plane beneath it very rapidly.

Another curve, prepared from data taken seven days after irrigation, illustrates an increase in the loss of this moisture below the root zone, as is indicated by a rising percentage below the 6-foot depth.

The limit curve beyond which moisture should not be drawn, owing to the porosity of the soil, shows also a loss below the 6-foot zone.

To eliminate loss in this soil it would be necessary to irrigate according to the slope line, applying 19 per cent moisture to the surface and tapering it off to 6.4 per cent at a depth of 5 feet. This could be accomplished by greatly increasing the rate of application—i. e., irrigating a greater number of acres in a given time, which can be done by increasing the head or varying the strip of land between borders.

Another moisture diagram for land irrigated by the furrow method shows that the conditions are equally ideal, though usually in the furrow method the moisture is not distributed to so great a depth as by the flooding method. There is little or no loss of moisture below the 5-foot depth in this instance.

### METHOD OF OBTAINING UNIFORM DISTRIBUTION OF MOISTURE BY FLOODING.

It might be supposed that it is a physical impossibility to apply water by the flooding method so as to obtain a uniform absorption of moisture over each square foot of land, thus obtaining a uniform vertical distribution of just the amount of moisture necessary. Not so, however, and that the idea is fallacious will be shown.

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I have, heretofore, mentioned the difficulties usually encountered, the generally prevailing practice, and the theoretically ideal method of applying irrigation water. But we are confronted with conditions which it is not practicable to alter; hence must so revise the method as to meet the needs.

A very thorough study has and is being made of the problem, both at the Higley Experiment Station (Arizona) and upon numerous irrigated fields in that section. At the experiment station 27 plots were accurately laid out as to contour, 0.11 of an acre area in each plot. Nine of these plots were artificially sloped to a gradient of 10 feet per mile, while 9 more were brought to a gradient of 6 feet per mile, and the remaining 9 plots to a flat surface.

By an arrangement of Cipoletti weirs, a set of 3 plots of the varying gradients mentioned is supplied with a certain head of water for a given time. Another set of three weirs is supplied by the same head during one and a half times the time of the first duration; and upon another set twice the original time is employed in irrigating These experiments are duplicated under variable heads.

By this means a relation between gradient, head (quantity rate of flow), and time or duration of application can be studied; 972 soil samples are taken after each irrigation so that the moisture distribution and penetration may be accurately studied. Coefficient evaporimeters are used at this station with a view to studying the performance of various soil types under similar conditions of duty.

It has been found that the head employed in irrigation by flooding is governed by the gradient and length of border, while the time of application is the controlling factor in securing depth of penetration. Uniformity of vertical penetration is dependent upon the homogeneity of the soil. Obviously, then, with a constant soil type; that is, a soil of homogeneous construction throughout the entire length and of identical construction throughout its depth will uniformly distribute moisture throughout each strata of varying thickness if applied uniformly on the surface, the depth to which a given percentage of moisture is delivered being a time function.

This function of time really establishes the rate at which the moisture is absorbed from the surface. It has been demonstrated in these investigations that if the rate of absorption is constant throughout a strip of land, then the water front, in advancing the length of the land, will likewise be at a constant rate. Therefore, if we can ascertain the rate of absorption of the soil, then, with a given rate of penetration, the time required to deliver the necessary moisture to any depth may readily be ascertained and a perfectly uniform distribution, both laterally and vertically, will be possible. Limiting the depth of penetration will, in this way, eliminate waste by deep penetration beyond the root zone.

Primarily, then, it is necessary, if the ideal is attained, to know the rate of penetration of the soil. This varies with the type of soil, being slower for a close, clay soil than for a sandy or loose soil; more rapid for a soil containing humus than for a soil without humus; and relatively high for a sandy or gravelly soil. It varies with the physical condition of the soil, being high for cultivated and low for compact soils. It varies in many ways with the crop and condition of the crop. It varies with the system of irrigation employed.

To illustrate this point, four penetration curves may be taken—three of them for a sandy clay soil and one for a more porous sandy clay loam soil.

These curves represent an uncultivated condition, the furrow method of irrigation, and the flooding system in different soils. These penetration curves must be obtained for the soil to be considered and under crop condition existing.

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For example: Let us take the case illustrated in the above mentioned moisture diagram. It was found that it was desirable to supply 10.7 per cent of moisture to a depth of 5 feet. The penetration curve, giving the flooding system in different soils, shows that it requires 2 hours and 37 minutes to supply that average moisture to the required depth. Then, since the plot contains $\frac{49.5 \times 90}{43560} = 1.023$ acres, the rate of irrigation of the strip must be $\frac{157}{1.023}$ or 1 acre in 153.4 minutes, closely 2½ hours.

This, then, is the rate at which this soil should be irrigated, but the rate must be continued uniformly throughout the entire length of the strip of land in order to supply the moisture uniformly. This will again be referred to shortly.

The head necessary to deliver this quantity rate is obtained in the following manner: The quantity of moisture desired in this instance is 10.7 per cent by weight, distributed throughout 5 feet in depth; but a soil always contains a residual moisture, and, since we allow 0.5 per cent in excess of the residual, or 5.5 per cent, we need supply but 10.7—5.5, or 5.2, per cent during the irrigation.

The soil under discussion, containing 10.7 per cent of moisture, weighs 100 pounds per cubic foot; therefore 1 square foot of the soil to a depth of 5 feet would weigh 500 pounds, and 5.2 per cent of that weight would be $5.2 \times 500$ of 26 pounds of moisture necessary to supply the soil, equivalent to $\frac{26}{62.5}$ or 0.42 cubic feet of water content per square foot of area, or over the total area within the strip it would be equal to $49.5 \times 900 \times .42$, or 18,711 cubic feet, to be delivered in 157 minutes. This is equivalent to a flow of 119 cubic feet per minute or 1.98 cubic feet per second.

Actually the field in question required 2 cubic feet per second, but the moisture had been exhausted to the 5 per cent residual curve shown in the moisture diagram, thus not allowing the 0.5 per cent for safety from wilting, and which, if taken into account in this example, would have brought the head necessarily required for irrigation to almost exactly 2 second-feet.

The data from which the above illustrations are given was obtained from soil moisture determinations taken in the center of the strip of land, hence are an average of that section only, and, while the irrigation was performed in the time given above, it was not at a uniform rate, as moisture determinations upon other parts of the field showed. However, had the advance of the water been uniform, the same uniform moisture content would have been obtained throughout the entire length of the strip. This is self-evident since, while a small percentage of water is lost in each foot the water advances, it may travel a considerable distance before the increments of loss will materially affect the remaining quantity flowing. This has been demonstrated in a great many instances in our investigations.

I have prepared an advance curve of this tract of land. One curve in this diagram represents the rate of advance of the water actually applied along the strip of land. The ordinates represent time in minutes and the abscissæ represent lengths. As the water advances it departs but slightly from a tangent to the 400-foot distance, but from that point it departs with a constantly increasing increment. Therefore up to the 400-foot point the rate of delivery of moisture to the soil is practically uniform, but beyond that point there is a tapering off of the delivery, hence the rate at which water is being supplied at the inlet end of the strip is not sufficiently great to continue the delivery so as to conform to the tangent, marked B in the diagram, which represents an absolutely uniform rate of advance.

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The slope of the tangent may also represent the rate of irrigation, in which instance it will give the proper time for irrigation of the strip of land and the rate of absorption will be absolutely constant. For instance, the tangent marked C, intersects the coordinate at 900 feet and at 157 minutes, the distance (900 feet) on this strip of land corresponding closely to 1 acre. Then at 450 feet the time is shown to be 78.5 minutes; and if the water is traveling at a uniform rate it will have irrigated one-half an acre in one-half the time. Therefore the rate of irrigation is constant and the advance of water is at a constant rate.

In actual practice this desired end can be attained by (first) changing the rate of irrigation at the point where the advance departs from a tangent by increasing the head and increasing the number of applications, then (second) by decreasing the width of the land strips between borders, and (third) shortening the length of the lands or strips.

Excepting in fields to be newly laid out, the latter two methods, of course, can not be employed, though either one may be compensated for by varying the head. The first method, however, may be employed in a large majority of instances, varying the number of applications as the condition of crop or soil requires, and is the most rational method for irrigating by flooding.

For example: Let us suppose, in a field with 1,000-foot lands, the rate of advance were, say 1 acre per hour up to the 500-foot point, but were reduced to one-half acre per hour during the remaining 500 feet. These rates are generally known by the successful irrigator who follows the flow of water, watch in hand, as it advances. Now twice the head applied would increase the advance at twice the rate; hence the water would advance across the entire field at a uniform rate. But since the rate has been increased by doubling, the actual time that the water would be in contact with the land would be one-half that obtained with the first 500 feet; therefore we might say that the penetration curve showed this time to be but one-half that necessary to deliver the moisture to the depth required. Then two applications at the same rate would accomplish the desired result and uniformly distribute the water.

Another figure prepared by me shows a similar advance curve for a sandy clay soil having less humus than is found in the soil represented by the above-mentioned advance curve. The advance of water in this instance is more nearly uniform and closely adheres to a tangent to a distance of 1,150 feet and then departs but 0.5 per cent, which deviation is well within the range of permissible departure.

Two additional figures represent advance curves of land in Idaho, which I have prepared from data compiled by Mr. Bark, of this office. One of these shows a relatively constant advance a distance of 817 feet, to obtain uniform lateral distribution, while the uniform rate in figure 16 continued to 840 feet. In both of these instances the advance curve rapidly departs from a tangent beyond these points.

When a soil has been rated in the above manner and the proper rate in acres per hour which will successfully and uniformly distribute water laterally is known, then the number of applications may be varied to suit any condition of soil or crop, and waste of water will have become a past menace.

Considerable space might be devoted to a discussion of the various soil types and their effect upon irrigation. In general, it might be said that the rather close soils are more easy to irrigate, and obtain a uniform penetration and retain the moisture over a longer time, since they give up their moisture less freely than the coarser soils. Such soils seldom contribute to loss by deep percolation, but overuse of water more quickly renders them alkaline and necessitates drainage. On the other hand, open soils are more difficult to irrigate

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uniformly and afford opportunities for waste and ununiform crop production. They less frequently become water-logged themselves, but contribute to the water-logging of the soils lying below.

The presence of humus in soils influences very greatly the moisture transmission rate, but all of these factors have to do with the penetration rate and do not influence the water advance rate or the irrigation rate; hence, when a field has been properly rated—i. e., the irrigation rate in number of acres irrigated per hour—it will remain a fixed quantity, the head or number of applications per irrigation being varied to meet the needs.

Now, while I have endeavored to explain each step necessary to scientific and proper irrigation practice, it may appear difficult in carrying out, but a diligent study of the methods explained will impress their simplicity. The only implement or instrument needed to ascertain the proper procedure is a soil auger and a balance for weighing samples. These, it is realized, are not available to all irrigators, and this office hopes to have soon available a soil moisture meter which will show the moisture content of the soil by direct indication; but a soil auger alone and the old system of balling the soil in the hand will serve as a fair index to the presence of growing moisture, and even this crude method will show when water is being supplied in such excess quantity as to become lost below the root zone. Next to the shovel the soil auger is the most important adjunct to irrigation farming.

## Adjournment.

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## JOINT SESSION OF SUBSECTION 1 OF SECTION III AND SUBSECTION 2 OF SECTION VII.

RALEIGH HOTEL,
*Thursday morning, December 30, 1915.*

Chairman, M. R. CAMPBELL.

The meeting was called to order at 10 o'clock by the chairman.

Papers presented:

Petroleums and asphalts in the United States, by E. W. Shaw.

Petroleum resources of Ecuador, by C. D. Andrade.

Conservation of the oil and gas resources of the Americas, by Ralph Arnold.

The petroleum resources of Mexico, by D. T. Day.

The CHAIRMAN. We have been, in previous sessions, taking the census of the mineral resources of the United States and of the other countries as far as they can be ascertained. The papers this morning are along this line, and I trust they will give us a good idea of the petroleum resources of the United States as well as of the other countries represented at the congress.

The first paper on the program, "Petroleum and asphalt in the United States," is by Mr. E. W. Shaw. He is familiar with the oil fields of this country and I am sure can give a good account of them as well as of the asphalt situation. I take pleasure in introducing Mr. E. W. Shaw.

### PETROLEUM AND ASPHALT IN THE UNITED STATES.[1]

By EUGENE WESLEY SHAW,

*Geologist, U. S. Geological Survey.*

#### INTRODUCTION.

The salient feature brought out by a brief review of the petroleum industry of the United States is its stupendous growth. Three-quarters of a century ago oil wells, pipe lines, and refineries were unknown and unforeseen. Fifty years ago the total production of petroleum was little greater than that of the small pools to-day, and a decade or two later the price was still fluctuating between wide limits and showed only a distant relation to production. With the possible

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exception of the development and exploitation of aluminum and of radium ores the recovery of petroleum is by far the youngest of the great mining industries. In volume of output few materials drawn by man from the earth can compare with it; in value few other minerals are in its class; and in the extent to which it has diverted human activity into new channels it ranks with the telephone and other devices making use of electricity. Asphalt mining, though an older industry, is comparatively of minor importance, because apparently the workable deposits of asphalt are of much smaller extent.

### GEOGRAPHY.

The oil pools of the United States may be classified geographically, commercially, chemically, stratigraphically, structurally, and in other ways. Geographically, most of them lie in three general regions—the eastern, south central, and western. The eastern region is commonly subdivided into the Appalachian, Lima-Indiana, and Illinois fields; the south central into the Mid-Continent and Gulf fields.

In volume of output, as well as number of pools, these three principal regions rank about alike. The eastern region, comprising the great fields of Pennsylvania, West Virginia, Ohio, Indiana, and Illinois, is bordered on the east and south by a belt of nonproductive territory along the Atlantic coast, including New England and the Coastal Plain of the southeastern United States. To the southwest are the scattered pools of Kentucky and Tennessee. To the west and northwest is another belt of thus far nonproductive States made up of Arkansas, Missouri, Iowa, Minnesota, and Wisconsin.

Beyond these States, to the west and southwest, is the south-central region, which comprises Louisiana, eastern Texas, Oklahoma, and southeastern Kansas. This region also is surrounded by a broad area which is barren or nearly so. Several oil pools, including some of considerable importance, occur in the Rocky Mountain States of Colorado, Wyoming, Utah, and New Mexico.

A little oil has been found in Oregon and Washington, but all the commercially important pools in the far West lie within the State of California, which in recent years has ranked first among the States producing petroleum, its output ranging from a fourth to a third of that of the entire country.

Many pipe lines connect the pools of each region with one another, with refineries, and with seaports. The eastern region finds its sea outlet in or near New York and Philadelphia; the south-central region at Port Arthur, on the Gulf of Mexico; and the western region at several California ports. The regions are not connected by pipe lines except that the oil of the south-central region has an eastward outlet, some of it being taken northeastward across Missouri to refineries near Chicago and St. Louis, where connections are available to eastern seaports.

### GEOPHYSICS.

*Relations to depth and altitude.*—The petroleum occurring in the United States is found at varying levels from the surface of the earth down to several thousand feet below the surface, but the greater part of it seems to lie at depths between 800 and 2,500 feet. Pools of oil on the surface are not common or large, and their chief importance lies in the suggestion which they offer that underneath or not far distant there may be valuable pools. Considerable oil is being obtained from wells less than 800 feet deep, and some from wells less than 200 feet deep. The shallow wells generally have small daily yields, but presumably owing to the general absence of gas pressure many such wells are long lived. The

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oil from them is commonly of a lower grade than deep-seated oil in the same district. Although numerous wells have been sunk to greater depths than 2,500 feet, some to 5,000 or 6,000 feet, and one in the Burgettstown region, Pennsylvania, is now more than 7,300 feet deep, little oil has been obtained from such great depths.

There seems to be little relation between oil pools and altitude. However, most of them are found in country less than 2,000 feet above sea. They are not found in high mountain ranges, but presumably this is due chiefly to the compression of the ranges, the absence of suitable containing rocks, and the tendency of both oil and water to drain away from such places. Some pools are above and some below sea level.

*Relations to pores and cavities.*—Petroleum occurs in rock cavities of many kinds, but probably more than 99 per cent occupies the pores of sand or sandstones. The pores are commonly less than a hundredth of a millimeter in diameter, and yet the oil may flow from them into wells at the rate of thousands of barrels a day. Some wells yield daily scores of thousands of barrels of oil, not from large subterranean caverns but from the pores of sand or sandstone. However, wells yielding such large quantities have become enlarged at the bottom from caving or from being "shot," so that the cross section of the stream of oil where it emerges from the sand is considerably greater than it would normally be.

In almost any cavity where oil and water touch each other a capillary force continuously presses upon the oil, and in rock pores this force must be great and must tend to crowd the oil into the larger pores. Gas, which is generally associated with oil, is undoubtedly affected by a similar pressure. The fact that oil and gas are found in the largest rock pores and in the coarsest sandstones is apparently due to capillarity. But in an oil-bearing sandstone there is no sharp distinction in size between the pores that contain oil and those that contain water. It would seem that under static conditions the most that capillarity could do would be to make the pools mixtures of small particles of oil and water, for as a rule small pores are thoroughly intermingled with the large pores. Instead the oil occupies pores of all sizes throughout a considerable body of sandstone, and the water all the pores in a contiguous body underneath or beside that containing oil. Nevertheless, the fact that oil is found in rock having, on the whole, large pores seems to point almost conclusively to capillarity as the major cause of its distribution with reference to pore size.

The frictional resistance to the flow of oil or water through rock pores is comparatively very low for sandstone and very high for shale. Rocks having large pores that are nearly closed also, of course, offer great resistance to flow, and in any case friction increases with pressure. It must, therefore, be an important factor in oil migration and accumulation. Plastic materials, such as clay and perhaps some asphalt-bearing sandstones, may even be self-clogging and may offer greater resistance than if they were nonplastic.

*Relations to gravity.*—The precise location, shape, extent, and number of oil pools seem to be intimately related to hydraulic and hydrostatic forces. Most, if not all, pools are surrounded by water, which occupies the pores of the adjacent rocks, and the pressure of the water against the oil, or of the two against each other, is commonly hundreds of pounds to the square inch. On account of deformation of the earth's crust, changes of temperature, settling and compacting, tidal stresses, and other causes, the fluids occupying the pores in rocks are moved about to a greater or less extent, and all such movements must give opportunity for the relief or equalization of gravitational stresses.

One of the most interesting problems in oil geology is the question how far oil may migrate within the earth. Apparently most pools are now very tightly

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shut in. It often happens that a pool is drained and the pressure reduced to zero, and then a well is sunk through a few feet of shale to a deeper sand containing oil under great pressure. Perhaps capillarity is the principal cause of the failure of the lower oil to move up through the few feet of shale to the sand in which the pressure had been relieved. On the other hand, under some circumstances oil migrates like a veritable Wandering Jew, but this seems to require a dry medium, and it is not known that any rock at a considerable depth is ever quite dry. One investigator suspects that oil may even pass through glass, because tightly closed glass bottles of oil become greasy on the outside.

*Physical relation with other minerals.*—The idea has been expressed that there may be a physical relation between oil pools and certain solid minerals, for oil will cling to some minerals more tenaciously than to others, and this property has been used in ore concentration. It has also been suggested that oil was originally deposited with clay, for oil will cling to fine particles of clay as they settle through water.

### GEOCHEMISTRY.

The chemical problems of petroleum concern chiefly its origin and the transformations through which its component substances have passed in reaching their present form. However, laws of physical chemistry also have undoubtedly affected its migration and accumulation. Many investigators believe that petroleum was once a part of living organisms—that it has derived from the remains of plants or animals, or both, which have been buried in the great bodies of sediment that have accumulated in the unnumbered ages of geologic time. If so, was it formed during, soon after, or long after the burial of these remains? What forces drove it off from them, and what kind of modification has it undergone since it was driven off? Petroleum is not found in present-day areas of sedimentation, but marsh gas is common in such areas. Could it have been evolved from marsh gas? Probably not, for under the known and presumable conditions of oil accumulation, the principles of physical chemistry seem to call for reactions of an opposite kind—for changes from the more complex and unstable compounds to the more simple ones, and marsh gas is the simplest and most stable of all substances found in petroleum. The absence of petroleum from very recent deposits seems to indicate that it is formed long after the organic remains are buried and perhaps very slowly. To determine what conditions of temperature and pressure are necessary for the formation of an oil pool is a problem upon which little progress has been made. Is the salt water which is generally associated with oil pools fossil sea water, and has it played any chemical part in the formation of petroleum? It has often been suggested that the salt has had some kind of pickling effect on the organic matter, and it is known that chlorine and also sulphur effect certain reactions which hydrocarbons undergo. What chemical part may other associated substances play? It has been shown that when oil is forced through fuller's earth it is separated into parts that differ in composition. The geochemistry of petroleum seems at present to be one long list of queries.

### GEOLOGY AND THE SEARCH FOR PETROLEUM.

The search for oil has involved almost as much of romance as the thrilling and adventurous search for gold. The discovery of a new oil pool brings about a boom with an inrush of prospectors and speculators quite comparable with the stampede caused by a precious-metal discovery. Even conservative and

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experienced companies sometimes seem to catch the fever and pay unreasonable prices for property within a radius of several miles from the discovery.

Much of the prospecting for oil, or "wildcatting," as it is called among oil men, has been carried on by somewhat hit or miss methods which are very costly. Indeed, the cost would have been prohibitive were it not for the large quantities and wide distribution of the oil. If the saying that more riches have been put into the ground than have been taken out is true of the search for gold, how much more would it be true of the search for petroleum. The locations of many wells have been selected by the aid of devices corresponding to the dip needle and the forked twig or through mistaken ideas of a relation between oil pools and surface features, vegetation, and distant oil pools, or through supposed indications afforded by occult or psychologic phenomena. Many a prospector walks or rides about until he has the right "feeling in his bones" and then drills; and owing to the great abundance of oil compared with other valuable minerals, he is sometimes successful, though of course more often he fails.

However, the search for oil in unproved territory has not been carried on altogether by chance or by unreasonable methods. In all three of the great oil regions of the United States the first knowledge of oil seems to have been obtained either from seepages or incidentally in drilling for water, and many of the individual oil pools have been thus discovered. A great majority of the wells of the country have been sunk adjacent to productive wells. Perhaps more than half have been surrounded by productive wells, either near by or at a short distance, and were thus sunk in practically proved territory. A well sunk on the margin of an area already producing oil is of course much more likely to be successful than one at a distance, other things being equal. Furthermore, oil pools commonly have a more or less pronounced general trend, so that the chances of finding oil on two of the sides of a newly discovered pool are greater than those of finding oil on the other sides.

In recent years the science of geology has been called upon more and more to aid in the search for oil and to supply some reasonable basis for the location of "wildcat" wells. Probably the most useful contribution made by this science is a principle evolved early in the history of the oil industry, but little used until lately, and even now not so widely used as it should be, in the opinion of geologists, at least. This principle is to the effect that anticlines or upwarps in the strata are more likely to contain oil than synclines or downwarps. The reason why this should be true is a matter of discussion, but the opinion is generally held, and apparently well founded, that because oil is lighter than water, which is generally found in the same stratum of rock, it has a tendency to rise to the highest spot attainable. In application, however, the anticlinal principle has some shortcomings, which arise out of the facts that in some districts it is difficult to determine the locations and forms of anticlines, and that many anticlines do not contain oil and some synclines do. The fact remains that in drilling for oil in unproved territory it is wise to search for an anticline and drill on it.

The application of the anticlinal principle is in some places easy and in some places difficult. For example, in regions which are nearly flat and which are underlain by a persistent and extensively mined bed of coal the search for anticlines is a simple matter. Roughly speaking, the place where the coal is nearest to the surface is the place to drill for oil. In regions where the surface is hilly and is underlain by one or more accessible, persistent, and easily identified beds only the additional labor of running level lines is involved. Commonly, however, persistent and easily identified beds are lacking, and as the dip of the strata is low it is difficult to determine the nature of the

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underlying rocks, and here the skill of the trained geologist is needed, for use must be made of such criteria as fossils, surface features, and obscure lithologic characters.

Geology also furnishes a basis for the conclusion that it is foolish to drill in areas of pre-Cambrian rocks, because no materials sufficiently porous to act as oil reservoirs underlie such areas. This at once rules out wide regions that can be readily delimited. On the other hand, it may be that, other things being equal, the chances for finding oil in strata that are predominantly porous are fewer than those for finding oil in strata a large part of which are impervious. The reason is that where most of the rocks are porous the circulation of underground water has proceeded with much greater facility, and any liquid or gaseous hydrocarbons which may have existed in the rocks are more likely to have been washed out. For a somewhat similar reason it seems probable that oil pools are less likely to be found on geanticlines or very broad and high upwarps with subsidiary anticlines and synclines than in geosynclines, for in the geanticlines the circulation of water has been much more free, and any oil that may have been present is likely to have been either lost at the surface or to have migrated into adjacent basins.

Except for the fact that pre-Cambrian rocks do not contain valuable pools, the age of the rocks underlying a region does not throw much light on its possibilities for petroleum. However, only a very small percentage of the total production of petroleum has come from strata older than Ordovician or younger than Tertiary, and all that has been found in such beds may have originated in other beds.

David White has recently set forth convincing arguments that the occurrence and quality of oil show a relation to the degree of metamorphism which the earth's crust, particularly the carbonaceous parts, has undergone, and on this basis he has pointed out certain regions where valuable pools of oil are not likely to be found.

In still other ways geology is, or promises to be, of use in the search for petroleum. Where anticlines are lacking or poorly developed, the geologic-structure map is still found useful, for the structure of the strata is nowhere altogether featureless, and it is always possible to select certain features which are more promising than others. Königsberger has argued that in oil fields the underground temperature rises more rapidly with increasing depth than it does in barren areas. It has been suggested that relations exist between isogonic lines, anomalies of gravity, and the transmission of such electrical waves as are used in wireless telegraphy and the occurrence of oil pools. Whether or not these suggestions will be usable remains to be determined.

The results of scientific research concerning the origin of petroleum are apparently of less value to the prospector than those concerning the mode of its accumulation. To most investigators in the United States it seems probable that petroleum is of organic origin, and many of them believe that most of it has been derived from plant remains. The basis for these opinions is about as follows: Carbonaceous remains of plants are very abundant in the strata in which oil occurs—probably far more abundant than those of animals; for plants decay less readily than animals and their fossils are generally carbonaceous, whereas animal fossils are rarely so. Any hydrocarbon found in petroleum can be made in the laboratory from either plant or animal matter. On the other hand, although it is possible to make the hydrocarbons from inorganic materials, such materials are not known to occur in the earth in any notable quantity, and if the oil were formed from such materials or were an

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original part of the earth, all of it must have migrated far from its source, for the pools are not found in areas of deep-seated rocks, but are now closely confined in the midst of sedimentary strata, thousands of feet thick, whose history is well known.

The problems of oil geology—of the origin and accumulation of oil—are somewhat baffling and yet most inviting. They are less complicated than certain problems of ore deposition in that the temperatures and pressures required have been less enormous, but more complicated in that they involve the chemistry of hydrocarbons.

### VARIETIES.

The physical and chemical properties of the petroleum of the United States range between limits so wide than in a short paper it is impracticable to make more than a few general statements concerning varieties. Some of the oils produced are very dark and heavy, and some are transparent and very light, but most of them are of intermediate character. The classification of petroleums according to whether they have an asphalt or paraffin base is not altogether satisfactory, but according to it the comparatively light oils of western Pennsylvania and adjoining areas form the largest bulk of those having a paraffin base. These oils, however, show great variety. Wells drawing oil from the same pool generally yield a rather uniform product, but the pools differ to a greater or less extent, and the oil from any region shows general differences from the oil of other regions. In many places where several standstones, one above another, contain pools of oil, the oil from each sand has characteristic properties, and yet the variation in any large group of oil pools is generally not sufficiently great to make practicable different prices for the oil from each pool. Where the variation is greatest the oil is commonly divided into two general classes, according to specific gravity, the oil of lighter gravity bringing a higher price.

David T. Day[1] has made the following summary statement concerning the quality of certain oils in the United States:

> The oils of the Appalachian field are simplest in composition, free from asphalt and objectionable sulphur, and capable of yielding products of the highest grade at minimum cost of refining. Contrasted with them is the petroleum of Lima, Ohio, and of the Indiana field. This contains little asphalt and consists chiefly of paraffin hydrocarbons similar to those in the Appalachian oils; but it is contaminated with sulphur compounds which necessitate unusual cost for their elimination by special processes. Once freed from the objectionable sulphur compounds the products are of high grade.
>
> Most of the oils produced in Illinois can be refined without the use of any special process, but only with great care and with small yields of the more valuable products. Some of the oils are asphaltic; some are not.
>
> Oils of the mid-continent field vary in composition within wide limits—from asphaltic oil, poor in gasoline and illuminants, among those found in Kansas and in the Healdton field of Oklahoma, to oils of much higher grade, especially those in the Cushing field of Oklahoma. The products extracted from the Healdton petroleum are of lower grade than from the other oils in Oklahoma (the Cushing pool, for example) on account of the sulphur, which approximates three times the average sulphur content of Oklahoma oils. This sulphur is present in a form resembling that of the Lima petroleum, and it has not been removed without special processes of refining.
>
> The oils from the Gulf field are characterized by varying but considerable percentages of asphalt and low yields in the lighter products. They also contain sulphureted hydrogen in solution and sulphur in other forms, the total percentage of sulphur being higher than in the mid-continent field or even in the Lima-Indiana field, but it can usually be more readily removed and without excessive cost.

[1] U. S. Geol. Survey, Mineral Resources, 1913, pt. 1, p. 944.

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The investigations of Prof. C. F. Mabery, of Cleveland, Ohio, and the experience of the oil refineries in the Gulf field, have shown that lubricating oils of exceedingly high quality are produced from these Gulf oils. The quantity of lubricating oils that can be produced in the United States is far greater than the market demands; and hence, as the oils of the Appalachian, the Lima-Indiana, the Illinois, and the Gulf fields have proved valuable and amply sufficient for the market, the quality of the lubricating oils which can be produced from the other fields has been left as a practically untested matter.

### REFINING.

*Fractionation.*—Most of the petroleum now reaches refineries by way of pipe lines, but a considerable part is still shipped by rail in tank cars. At the refineries it is subjected to distillation, a comparatively simple method of separating the petroleum into several parts having varying degrees of volatility, though each part is still made up of various hydrocarbons. These parts are then marketed under the familiar names, gasoline, kerosene, etc. All the separates from oils containing little asphalt are of considerable value, but the asphaltic residues of some other oils constitute a rather large part of the product of the refineries and form the chief part of the asphalt produced in the United States. The asphaltic residues are used extensively for fuel and for road dressing.

*Cracking.*—In recent years science has made an important contribution to the oil-refining industry by devising a practicable means of increasing the proportion of the lighter fractions produced in refining. The process used is known as cracking. Large plants take the heavier fractions, from which all or practically all the gasoline, etc., has been distilled away, and from these heavy residues produce large quantities of gasoline, through chemical changes induced by high temperature. High pressure is also used, but its purpose is not to facilitate the chemical change directly, but to make possible the use of a high temperature without volatilizing the oil. The apparent paradox of producing gasoline from a residue remaining after all gasoline has been extracted is explained by the fact that although all the gasoline has been taken out in the first operation, there remain other compounds from which more gasoline can be made.

### PRODUCTS.

Of the many commercial products of petroleum—gasoline, kerosene, lubricating oils, paraffin, vaseline, etc.—perhaps none need discussion in a brief paper except fuel oil, the production of which is a rapidly developing industry. Fuel oil is now competing with coal on railroads and in factories and is already extensively used, particularly in regions that lack extensive coal beds and in regions where large quantities of crude oil or residues from distillation are seeking a market. The cracking process of making gasoline is now tending to reduce the excess of such residues, the proportion of which is less than a third of what it was a few years ago, but nevertheless both the supply and the demand are continually increasing and prices are rising. In some cities fuel oil is even competing with natural gas in factories, and it seems probable that the demand for fuel oil for export will increase very rapidly.

### PRODUCTION.

Data collected by J. D. Northrop, of the United States Geological Survey, show that the total production of petroleum in the United States in 1914 was about 290,000,000 barrels, or about 40,000,000 metric tons. The table given below shows the marketed production and other statistics by States.



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*Petroleum marketed in the United States in 1913 and 1914.*

| State or region. | 1913 | | | 1914 | | | Increase or decrease, 1914. | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity (barrels). | Value. | Average price per barrel. | Quantity (barrels). | Value. | Average price per barrel. | Quantity. | | Value. | |
| | | | | | | | *Barrels.* | *Per cent.* | *Dollars.* | *Per cent.* |
| Alaska | (a) | (a) | | (a) | (a) | | | | | |
| California | 97,788,525 | $45,709,400 | $0.467 | 99,775,327 | $48,066,096 | $0.482 | + 1,986,802 | + 2.03 | +$2,356,696 | + 5.16 |
| Colorado | 188,799 | 174,779 | .926 | 222,773 | 200,894 | .902 | + 33,974 | + 17.99 | + 26,115 | + 14.94 |
| Illinois | 23,893,899 | 30,971,910 | 1.296 | 21,919,749 | 25,426,179 | 1.160 | − 1,974,150 | − 8.26 | − 5,545,731 | − 17.91 |
| Indiana | 956,095 | 1,279,226 | 1.337 | 1,335,456 | 1,548,042 | 1.159 | + 379,361 | + 39.68 | + 268,816 | + 21.01 |
| Kansas | 2,375,029 | 2,248,283 | .947 | 3,103,585 | 2,433,074 | .784 | + 728,556 | + 30.68 | + 184,791 | + 8.22 |
| Kentucky | 524,568 | 675,748 | 1.288 | 502,441 | 498,556 | .992 | − 22,127 | − 4.22 | − 177,192 | − 26.22 |
| Louisiana: | | | | | | | | | | |
| Northern— | | | | | | | | | | |
| Caddo | 9,781,560 | 9,812,342 | 1.003 | 7,572,254 | 7,177,535 | .948 | − 2,209,306 | − 22.59 | − 2,634,807 | − 26.58 |
| De Soto | | | | 3,834,593 | 3,649,922 | .952 | + 3,834,593 | | + 3,649,922 | |
| Red River | | | | 401,622 | 379,229 | .944 | + 401,622 | | + 379,229 | |
| Total | 9,781,560 | 9,812,342 | 1.003 | 11,808,469 | 11,206,686 | .949 | + 2,026,909 | + 20.72 | + 1,394,344 | + 14.21 |
| Coastal— | | | | | | | | | | |
| Jennings | 790,648 | 769,917 | .974 | 412,036 | 374,611 | .909 | − 378,612 | − 47.89 | − 395,306 | − 51.34 |
| Welsh | 31,144 | 26,745 | .859 | 18,629 | 17,614 | .946 | − 12,515 | − 40.18 | − 9,131 | − 34.14 |
| Anse la Butte | 6,612 | 5,220 | .800 | 18,623 | 17,036 | .915 | + 12,011 | +181.66 | + 11,746 | +223.04 |
| Vinton | 1,888,864 | 1,641,637 | .869 | 1,465,302 | 983,588 | .671 | − 423,562 | − 22.42 | − 658,049 | − 40.08 |
| Edgerly | | | | 586,376 | 287,362 | .490 | + 586,376 | | + 287,362 | |
| Total | 2,717,268 | 2,443,589 | .899 | 2,500,966 | 1,680,211 | .672 | − 216,302 | − 7.96 | − 763,378 | − 31.24 |
| Total Louisiana | 12,498,828 | 12,255,931 | .981 | 14,309,435 | 12,886,897 | .901 | + 1,810,607 | + 14.49 | + 630,966 | + 5.15 |
| Michigan | (a) | (a) | | (a) | (a) | | | | | |
| Missouri | (a) | (a) | | (a) | (a) | | | | | |
| New Mexico | (a) | (a) | | | | | | | | |
| New York | 948,191 | 2,284,307 | 2.409 | 933,974 | 1,760,868 | 1.875 | − 9,217 | − .97 | − 523,439 | − 22.91 |
| Ohio: | | | | | | | | | | |
| Southeastern | 4,964,425 | 12,229,610 | 2.463 | 4,809,265 | 8,937,415 | 1.858 | − 155,160 | − 3.13 | − 3,292,195 | − 26.92 |
| Lima | 3,817,043 | 5,308,842 | 1.391 | 3,727,087 | 4,435,314 | 1.190 | − 89,956 | − 2.36 | − 873,528 | − 16.45 |
| Total | 8,781,468 | 17,538,452 | 1.997 | 8,536,352 | 13,372,729 | 1.567 | − 245,116 | − 2.79 | − 4,165,723 | − 23.75 |
| Oklahoma | 63,579,384 | 59,581,948 | .937 | 73,631,724 | 57,253,187 | .778 | +10,052,340 | + 15.81 | − 2,328,761 | − 3.91 |
| Pennsylvania | 7,917,302 | 19,690,502 | 2.487 | 8,170,335 | 15,573,822 | 1.906 | + 253,033 | + 3.20 | − 4,116,680 | − 20.91 |

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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Texas: | | | | | | | | | | |
| Northern— | | | | | | | | | | |
| Corsicana | 158,830 | 156,844 | .987 | 133,811 | 123,556 | .923 | − 25,019 | − 15.75 | − 33,288 | − 21.22 |
| Petrolia | 344,868 | 342,783 | .994 | 550,585 | 465,628 | .846 | + 205,717 | + 59.65 | + 122,845 | + 35.83 |
| Powell | 282,476 | 216,402 | .766 | 282,279 | 169,490 | .600 | − 197 | − .07 | − 46,912 | − 21.68 |
| Electra | 8,131,624 | 8,142,797 | 1.001 | 8,227,968 | 6,789,359 | .825 | + 96,344 | + 1.18 | − 1,353,438 | − 16.62 |
| Marion County | 262,392 | 261,965 | .998 | 180,584 | 175,922 | .974 | − 81,808 | − 31.18 | − 86,043 | − 32.85 |
| Moran | ..... | ..... | ..... | 68,191 | 47,081 | .690 | + 68,191 | ..... | + 47,081 | ..... |
| Other | 4,062 | 4,394 | 1.081 | 8,204 | 7,919 | .965 | + 4,142 | +101.97 | + 3,525 | + 80.22 |
| Total | 9,184,252 | 9,125,185 | .994 | 9,451,622 | 7,778,955 | .823 | + 267,370 | + 2.91 | − 1,346,230 | − 14.75 |
| Coastal— | | | | | | | | | | |
| Batson | 741,350 | 670,323 | .904 | 775,804 | 632,926 | .804 | + 34,454 | + 4.65 | − 37,397 | − 5.58 |
| Dayton | 13,329 | 10,633 | .797 | 18,791 | 8,813 | .469 | + 5,462 | + 40.98 | − 1,820 | − 17.12 |
| Goose Creek | 249,641 | 206,311 | .826 | 134,748 | 79,012 | .586 | − 114,893 | − 46.02 | − 127,299 | − 61.70 |
| Humble | 1,504,880 | 1,453,158 | .965 | 2,799,458 | 1,535,468 | .548 | + 1,294,578 | + 86.03 | + 82,310 | + 5.66 |
| Matagorda County | 294,553 | 266,338 | .904 | 164,192 | 98,203 | .598 | − 130,361 | − 44.26 | − 168,135 | − 63.13 |
| Orange County | 17,706 | 19,123 | 1.080 | 43,206 | 44,223 | 1.023 | + 25,502 | +144.03 | + 25,100 | +131.26 |
| Saratoga | 937,720 | 855,935 | .913 | 839,743 | 647,075 | .727 | − 47,977 | − 5.12 | − 208,860 | − 24.40 |
| Sourlake | 1,348,053 | 1,350,379 | 1.000 | 5,209,208 | 3,534,720 | .679 | + 3,861,155 | +286.42 | + 2,184,341 | +161.76 |
| Spindletop | 716,374 | 716,993 | 1.000 | 580,130 | 582,388 | 1.004 | − 136,244 | − 19.02 | − 134,605 | − 18.77 |
| Other | 1,620 | 1,215 | .750 | 1,280 | 1,065 | .832 | − 340 | − 20.98 | − 150 | − 12.35 |
| Total | 5,825,226 | 5,550,408 | .953 | 10,616,562 | 7,163,893 | .675 | + 4,791,336 | + 82.25 | + 1,613,485 | + 29.07 |
| Total Texas | 15,009,478 | 14,675,593 | .978 | 20,068,184 | 14,942,848 | .745 | + 5,058,706 | + 33.70 | + 267,255 | + 1.82 |
| West Virginia | 11,567,299 | 28,828,814 | 2.492 | 9,680,083 | 18,468,540 | 1.908 | − 1,887,266 | − 16.32 | −10,360,274 | − 35.93 |
| Wyoming | 2,406,522 | 1,187,232 | .493 | 3,560,375 | 1,679,192 | .472 | + 1,153,853 | + 47.95 | + 491,960 | + 41.44 |
| Other | [b] 10,843 | [b] 19,263 | 1.777 | [c] 7,792 | [c] 14,291 | 1.834 | − 3,051 | − 28.14 | − 4,972 | − 25.81 |
| Total | 248,446,230 | 237,121,388 | .954 | 265,762,535 | 214,125,215 | .806 | +17,316,305 | + 6.97 | −23,006,173 | − 9.70 |
| SUMMARY. | | | | | | | | | | |
| Appalachian | 25,921,785 | 63,708,981 | 2.458 | 24,101,048 | 45,239,201 | 1.877 | − 1,820,737 | − 7.02 | −18,469,780 | − 28.99 |
| Lima-Indiana | 4,773,138 | 6,588,068 | 1.380 | 5,062,543 | 5,983,356 | 1.182 | + 289,405 | + 6.06 | − 604,712 | − 9.18 |
| Illinois | 23,893,899 | 30,971,910 | 1.296 | 21,919,749 | 25,426,179 | 1.160 | − 1,974,150 | − 8.26 | − 5,545,731 | − 17.91 |
| Mid-Continent | 84,920,225 | 80,767,758 | .951 | 97,995,400 | 78,671,902 | .808 | +13,075,175 | + 15.40 | − 2,095,856 | − 2.59 |
| Gulf | 8,542,494 | 7,993,997 | .936 | 13,117,528 | 8,844,104 | .674 | + 4,575,084 | + 53.56 | + 850,107 | + 10.63 |
| California | 97,788,525 | 45,709,400 | .467 | 99,775,327 | 48,066,096 | .482 | + 1,986,802 | + 2.03 | + 2,356,696 | + 5.16 |
| Colorado and Wyoming | 2,595,321 | 1,362,011 | .525 | 3,783,148 | 1,880,086 | .497 | + 1,187,827 | + 45.77 | + 518,075 | + 38.04 |
| Other | [b] 10,843 | [b] 19,263 | 1.777 | [c] 7,792 | [c] 14,291 | 1.834 | − 3,051 | − 28.14 | − 4,972 | − 25.81 |
| Total | 248,446,230 | 237,121,388 | .954 | 265,762,535 | 214,125,215 | .806 | +17,316,305 | + 6.97 | −23,006,173 | − 9.70 |

[a] Included in "other."

[b] Includes Alaska, Michigan, Missouri, and New Mexico.

[c] Includes Alaska, Michigan, and Missouri.

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### COMMERCE.

Comparatively small amounts of petroleum or petroleum products are imported into the United States. The largest shipments consist of crude petroleum from Mexico and amount to 15,000,000 or 20,000,000 barrels a year. Small quantities of paraffin and gasoline are also shipped to this country from time to time.

Large quantities of all kinds of petroleum products are exported from the United States. According to David T. Day "between 4,000,000 and 5,000,000 barrels of crude oil are exported each year, and in 1913 about 200,000,000 gallons of gasoline and naphtha, slightly over 1,000,000,000 gallons of illuminating oil, over 200,000,000 gallons of lubricants, over 300,000,000 gallons of gas oils, and more than 27,000,000 barrels of residuum were exported. In all, reduced to barrels, the exports amounted to 50,868,231 barrels in 1913, or 20.5 per cent of the total production."

### CONSERVATION.

In recent years considerable thought has been given to the avoidance of waste of petroleum and petroleum products, and this thought has not failed to bear fruit. However, the losses are still very great and are incurred at many stages in the recovery and marketing of the oils. Pools are not completely exhausted before being abandoned and yield less oil than they might with somewhat different handling; much oil, particularly the more volatile and valuable portions, is lost about the wells, in the storage reservoirs, and in shipping; and the losses by accident, particularly by fires, are enormous. Much of the waste of oil is due to the very natural desire of the producer for quick returns. His profits are larger if he takes as rapidly as possible the bulk of the oil from one pool, handles it in the least expensive way, and then goes to another pool, than if he sets about to recover every barrel of oil possible and to get it to the consumer with the least possible loss. If oil were less abundant it would be handled in a very different way. The oil resources of the country are not inexhaustible, however. The discovery of new pools to take the place of abandoned ones will not go on indefinitely, and the time may not be far distant when the output will become stationary or will decrease, and the increasing demand will force prices to considerably higher levels than have yet been reached. The waste evil may thus be remedied to some extent by natural means, but in the meantime losses beyond recovery are being incurred.

### RESOURCES.

The question, "How long will the United States continue to produce large quantities of petroleum?" is one of exceeding interest and importance. It is within the range of possibility that the number of undiscovered pools is as great as that of the discovered pools, but this is not at all probable. The average percentage of exhaustion of developed pools may not be more than 10 per cent, but is probably more and may be much more. The possibility that exhausted pools may become replenished is slight. The movements of underground fluids due to the withdrawal of oil, water, and gas and to natural causes may occasionally bring oil pools laterally into bodies of sand previously exhausted, but the possibility seems remote, because apparently oil is slow to enter water-wet sand. In any case such a pool would not be an addition to the number in existence but essentially a newly discovered pool. No doubt methods leading to more complete exhaustion of a pool—such as forcing air, water, or some solvent from one well to another through a sand—will be

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put into use, and the total amount recovered will be thus increased. In all probability the supply of petroleum will not last many centuries, and, although rising prices may keep the production at a high figure for many decades, the total supply may at the end of the century be only a very small percentage of the original. The redeeming feature of the situation is that the supply of rock from which artificial petroleum may be made is almost inexhaustible. The oil shales of the United States are already attracting much attention, and the time is probably not far distant when large quantities of oil will be produced from this source.

### ASPHALT.

No great deposits of asphalt such as that on the island of Trinidad exist in the United States, and yet asphalt is widely distributed throughout the country, and in a few places, particularly in California, it occurs in considerable bodies. Most of the asphalt of the country seems to be a residuum from bodies of petroleum of greater or less extent which have been evaporated at the surface. Much of it is probably all that remains of extensive oil pools that have been gradually evaporated. It is commonly assumed that the oil rose to the surface, but the idea that the surface has been lowered to the oil pool by the gradual erosion that has progressed throughout geologic time seems quite as reasonable and more generally applicable.

In a large part of the workable deposits of the country the asphalt impregnates porous rock, which is quarried and used for road dressing, etc. Such rocks are quarried in California, Kentucky, Oklahoma, Utah, West Virginia, and other States. But a larger quantity of asphalt is so widely disseminated as to be unusable.

The annual output of natural ahphalt and asphaltic rock in the United States amounts to a little less than 100,000 tons and is valued at somewhat more than $750,000. The quantity imported is more than twice as great, though its value is less than $1,000,000. The annual production of manufactured or oil asphalt amounts to about half a million tons, valued at 4 or 5 million dollars.

### LITERATURE.

The literature on petroleum and asphalt is of four principal kinds—detailed descriptions of particular areas, general treatises, papers discussing scientific or technical problems, and statistical reports. Publications of the first kind are numerous and are found principally among the reports of the United States Geological Survey and of the several State surveys. The general treatises published in the United States are not so good as the foreign ones, and the investigators of this country use largely the works of Thompson, Redwood, Engler, Hofer, and others. Scientific and technical papers are already numerous and are increasing in number; they are scattered through the volumes of scientific and technical journals. In this connection reference should be made to the many important petroleum news journals which owe their prosperity to the sensational nature of petroleum production and contain an immense amount of valuable information. Statistical data are published annually in the United States Geological Survey's volumes entitled "Mineral Resources," in a few of the news journals, and in reports of some of the State geologic or mining bureaus.

The CHAIRMAN. Mr. Shaw's paper is now open for discussion.

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Mr. DAY. Mr. Shaw has given us a very concise description of the oil and asphalt fields of the United States. However, I would like to call attention to the fact that certain things in the paper are classed together that should be put in separate groups. I refer, among other things, to the conception of Mr. Shaw that the oil fields should be divided into three principal regions in the United States. That involves, as I recall the paper, the idea of classing together the Appalachian oils of the United States, Pennsylvania and eastern Ohio and the other States, with the oil fields of western Ohio, Indiana, and Illinois. Mr. Shaw has very clearly referred to the modern methods of deriving from petroleum many different substances which do not naturally exist in the oil. These chemical methods of treating petroleum are becoming more and more important. Any consideration or classification, therefore, of the fields of the United States which facilitates this chemical study is of direct benefit, but any confusion is of direct harm. This classification into only three fields is directly harmful because it confuses the sulphur-bearing oil of western Ohio, Indiana, and Illinois with the oils of the Appalachian region, and for technical purposes those two oils deserve separate grouping, and it is a step backward to class them in any way together.

The writer refers to the fact that some of the oil is sent to the East from the Oklahoma fields. I would like to ask whether that is not a predominating feature of the trade in the Oklahoma oil? Mr. Shaw does not recognize, in considering the matter of capillarity, that the capillary force can not be responsible for driving oils from the small capillaries into the large ones. This capillary attraction, as we all know, increases with the smallness of the capillary tube and therefore the direction of the pull—and we must always think of capillary force as a pull rather than a push—tends to pull it into the finer capillaries and not to drive it into the larger ones.

Mr. Shaw has stated that oils in the earth do not move far by capillary migration, because of opposing forces which are soon brought into equilibrium. I would like to know whether Mr. Shaw is willing to go on record with the statement that oils move about by virtue of the deformation of the rocks, indicating that the oil was there as oil, and has not been brought into its present place of accumulation at a very much later date, long after the deformation of all rocks?

Mr. Shaw has spoken of compilations of statistics as though these statistical contributions were the products of other people and merely compiled. Having a great sympathy for the scientific men who are devoting their lives to that kind of study, I wish to put statistical work on the same scientific plane, if not a great deal higher one than the imaginative work. If the facts published as

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statistics by the Geological Survey had already been published, our system of guarding our figures until they are ready for publication would be wholly unnecessary.

I must make a definite exception to the statement in his paper that the work of the foreign scientific investigator in charge of the character and utilization of petroleum is better than that of the American investigator. Take, for example, as a concrete case, which, however, is not a simple isolated case, a work on which I am engaged. In preparing for publication a system of attacking the problem of the examination of petroleum, I have, during quite a number of years, been studying the work done by foreign physicists and chemists and have been comparing this work rather carefully with what has been done in the United States. When I began that work I believed that the work abroad had been done in a better way than in the United States. I find that that is not the case. The work in the United States has not been published so generally, and yet, when you come to consider its quality, we find that some of the best work done in the United States in the chemistry of oil far outranks that work which has been done abroad. That brings to our minds the gratifying conclusion that even the work of Prof. Engler, great as it has been and covering a tremendous range of problems, culminating in his studies on the viscosity of oils, is outdone by work in the United States. In other words, in this system of analysis it is impossible to adopt any of the foreign conclusions as to the best methods for the examination of petroleum. We find that our own methods in the United States are superior in the two vital points of exactness and quickness of execution. This, I think, is extremely gratifying to us all.

The CHAIRMAN. Are there any other remarks upon this paper?

Mr. CLAPP. In reference to the classification of the fields under the systems mentioned, I think we might go one step further than that. Of course, for Pan American purposes, it is quite valuable to make a group of the fields. Mr. Shaw's grouping into three general fields is of some practical value, but it is, on the other hand, misleading for exact purposes. The fields have been classified as the Appalachian, Indiana, Pennsylvania, West Virginia, the middle Oklahoma, and the California fields. Of course, that leaves out of account one great field in the Middle West extending through the States of Colorado, Wyoming, and into Montana, in which there have been not only considerable showings of oils, but some fields of considerable promise developed to the north in Alberta, where what is probably the largest gas field in the world has been developed; and where gas is found there will be oil somewhere. I think even for Pan American purposes it is important to include this central-western field, which will some day play a great part in the oil industry of the country.

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I think we might go a step further in classifying the fields geographically. Dr. Day has referred to the difference in character between the oils in the Indiana and Ohio fields as compared with those in Pennsylvania and West Virginia. We can even go further than that. We can say that the oils in Pennsylvania, New York, and eastern Ohio belong to the general class of paraffin oils and are of great value. These oils occur almost entirely in strata of Pennsylvanian, Mississippian, and Devonian ages. There is another field which is not very widely known, but it is of considerable importance. It is what is known as the Clinton sand field, extending through central Ohio from north to south. Those oils practically rank with the Pennsylvania oil. The oils from the northwestern part of the Clinton area have, I think, more or less asphalt. The northwesternmost oils are not a very great distance from the Trenton limestone field, where the oil is the sulphur oil, referred to by Dr. Day, and is heavier and commands a less price, having an asphalt base.

Any exhaustive treatment of oils must take into account the gradation between asphaltic and paraffin oils, and then we are brought up against this occurrence of the asphalt base oil in the Clinton sand in rather close proximity to the asphalt base oil in the Trenton limestone; but the southward gradation of that oil into a light paraffin oil has to be considered.

It seems to me that in any classification of the fields it is desirable to make subdivisions of each group of fields according to the different geological ages and the difference in character of the oil.

The CHAIRMAN. Undoubtedly a great degree of refinement could be gone into, but in the limits of time here it is impossible to consider all of the classifications. I think any classification to be adopted should be for some particular use, as geographical, geological, commercial, chemical, etc. The purpose of a classification is an important point. Are there any other remarks?

Mr. BALL. I think Mr. Shaw will possibly want to modify one ambiguous statement regarding the Rocky Mountain fields. As he read it it would seem he meant there were important fields in New Mexico. I am sure he did not mean to make any such statement.

The CHAIRMAN. If there are not any further remarks, we will pass on with the program. It is very gratifying to be able to present a paper here dealing with the South American conditions and especially by a gentleman who is a citizen of one of those States. I have the honor of presenting Dr. Andrade, who will give us a paper on "The petroleum resources of Ecuador."

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# OUTLINE OF THE PETROLEUM RESOURCES OF ECUADOR.

By CÉSAR D. ANDRADE,
*Guayaquil, Ecuador.*

In view of the interest taken nowadays in the study of the petroliferous land of the American continent, I wish to give a brief outline of the oil lands of Ecuador.

There are several places in Ecuador where petroleum has been reported, but I am going to speak only about the oil field at Santa Elena, which is the best known to me. The Santa Rosa oil field of Ecuador is also being reported as a prominent one, offering splendid opportunities, but I will not attempt its description for lack of sufficient information. However, I must state here that the Santa Elena and Santa Rosa oil fields present the same surface indications as the fields of Lobitos, Zorritos, Negritos, and Talara on the coast of Peru, which are great oil producers, and about 120 miles due south Santa Elena. The oil-bearing land to which I want to refer is situated on the peninsula of Santa Elena, the most western position of the Republic of Ecuador. The whole western portion of the peninsula is to be considered as oil-bearing land, inasmuch as very definite "seepages" of oil are found at many places over the whole area, which area would be about 600 square miles, with a probable extension in an eastward direction.

The geology of the peninsula is very well shown on the sea cliffs and presents a series of sandstones and marls, which probably correspond to the Miocene series, and are a continuation of similar beds in Peru. The oil-bearing formation throughout the largest part of this peninsula is composed mainly of a gray shell, which is underlaid by a very hard layer of sandstone. The shale deposits are saturated with oil, which is easily noticeable by its heavy dark color, while in a great many places it forms pools of oil. At the Bay of Ancon there are several natural flows, or petroleum springs, which distribute the oil freely in large quantities all along the sea beach. Oil is also seen on the sea water on many occasions and is lost in the ocean at the following places: In front of the village of Cangrejo, in the neighborhood of the port of Ballenita, in front of the lighthouse of Santa Elena, in front of the Punta de Mambra, and in Carolina.

The topography of the country is in part undulating to hilly, with many valleys and ravines. The portions of San Francisco, Ecuador, is situated on a plain which stretches from the Pacific Ocean to the Bay of Santa Elena, about 5 miles of the Promontory.

The places where petroleum exists near the surface can easily be detected by the discoloring of the underlying soil, as well as by the distinct smell which can be noticed at a distance of a few hundred feet from these places.

No development work of importance has been done at Santa Elena, but a considerable number of shafts and holes have been sunk from 10 to 50 feet deep. They are dug about 10 by 10 feet square. The odor and the pressure of gas from these wells have prevented any further development by hand power, although the supply of oil has gradually increased as a greater depth was attained. This work has been done during a number of years by different parties, and although most of these holes show the existence of a considerable quantity of oil in the strata a serious work has not been carried out. This is the more surprising, as flowing oil has been known to exist in Santa Elena for centuries.

After the earthquake shocks felt along the west coast from San Francisco, Cal., to Valparaiso, Chile, the hand-dug wells at Santa Elena have been pro-

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ducing oil in larger quantity and of a very much superior quality, and at the same time several springs started to flow which were unknown before the earthquake. Taking into consideration the very high grade of crude petroleum now being obtained at Santa Elena, and that these hand-dug wells have been capable of giving a yield of approximately 500 to 700 tons per month for a great many years, go to prove beyond a doubt that the oil-producing strata lies at greater depth than any yet attained.

A shaft was sunk to a depth of 35 feet at San Francisco. (Claims of Ecuador.) After passing through the overlying beds of clay and sandstones the oil-bearing strata was struck at a depth of 10 feet from the surface. It appeared in small seams intersected by sandstones which also contained oil. At 35 feet a larger supply of oil was found and there the work was stopped. I do not know for what reason. The shaft was sunk at the bottom of a slope bordering one of the numerous valleys to be found in this region. The oil is dark green in color, its specific gravity is about 0.900, and can be classified as a fuel oil, with about 20 per cent kerosene.

Undoubtedly the oil obtained in the handpits is not a fair sample for analysis, because it is so exposed to the elements that the valuable and more volatile contents have escaped. It is fair, however, to assume from the evidence obtainable, that the oil from this field will be of high value and will contain a considerable amount of the light oils.

The only work done of a more modern nature was the drilling of one well, which was carried down to about 2,000 feet and was stopped for want of capital. In this well oil was found in fairly good quantities on several occasions, also strong gas. The probabilities are that oil at depth in this well will be found to be abundant. From this well a sample was taken of oil encountered at 1,700 feet and sent to Paris, as I am informed, which, on analysis there, gave nearly 30 per cent of motor spirit, which is to be accepted as a high-grade petroleum.

An analysis made by myself of oil from a San Francisco claim of Ecuador (a hand-dug well) gave on an average the following results:

Color: Dark greenish-brown, with some fluorescence.

Specific gravity at 60° F., 0.918.

Kerosene, specific gravity 0.837, 36.90 per cent.

Lubricating oils, 53.10 per cent.

Coke, 5.40 per cent.

Sulphur, 0.63 per cent.

The climate of Santa Elena is healthy, and although only 3° south of the equator the temperature in the shade at midday seldom rises above 88° F. Fevers and other epidemic diseases are unknown there.

Labor is cheap and plentiful. The present rate of wages is from 50 cents to 75 cents (gold) a day. The men are both willing and intelligent.

In Ecuador a mining claim consists of 1,000 acres. The holder of a claim is entitled to all surface and mining rights, which are granted in perpetuity, for an annual payment to the Government of $80 per 1,000 acres. In this connection I wish to state that I am responsible in part for the liberal mining laws of Ecuador as they exist at present. As a member of the lower house, I put through, in 1914, a bill exempting owners from the payment of any taxes, fiscal or municipal, on their mines, or the products for 20 years, beginning with 1915. Machinery and all equipment for the work is also imported into Ecuador without payment of duty.

The oil field at Santa Elena is very well situated for marketing fuels and refined oils, owing to the close proximity of the Panama Canal, which will be the center of shipping activities in the near future.

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As the peninsula of Santa Elena is bounded by the Pacific Ocean, it is immediately tangible to all sea routes of the world, whilst all the steamers of the various steamship companies pass within a mile of the peninsula. This oil field is on the route of the steamers passing north and south, up and down the coast, and within 650 miles of the Panama Canal. In and around Santa Elena there are several small bays and every facility necessary for handling cargo and petroleum, and are a safe anchorage at all times. At many places on the coast the sea is sufficiently deep to permit vessels of fair draft to approach close to the shore, thus facilitating the landing of machinery, etc., which is effected by lighters, as is the case in many places down the western coast of South America. No difficulties present themselves for building piers for landing purposes on the coast of Santa Elena.

All the oil obtained now is sold for fuel in the city of Guayaquil to the electric-light plant, the brewery, the gas plant, and other industries, and they are not well supplied. A small quantity of oil is treated in a little refinery located on the beach at Santa Elena, which makes no pretense of saving anything but asphaltum.

I would draw your attention to the advantages of this oil field—first, the absence of pipe-line charges, as the field is in very close proximity to the coast, and the short transport and consequently low offshore freight to reach the markets which are at its doors.

In conclusion I wish to state that in my own opinion it only requires capital and intelligent exploitation to demonstrate that Ecuador is an important oil country and capable of eventually competing with the oil centers of the world.

The CHAIRMAN. The Chair begs to apologize to Mr. Shaw for not giving him an opportunity of replying to the criticisms made of his paper. Before Dr. Andrade's paper is taken up for discussion we will hear from Mr. Shaw.

Mr. SHAW. I wish to say, first, in regard to the classification of the oil fields over the United States, that we may classify the oil fields on various bases. The classification in my paper was geographic, and in that respect the oil fields fall clearly into three regions. You might classify them chemically and get different results; geologically, you would get another arrangement; and, as has been said, you might go to an indefinite degree of refinement.

As to capillarity, I think Dr. Day is mistaken and that capillarity can push oil into the larger pores because the force is greater for water than for oil. I think that another point should be made in that connection, viz., that capillarity requires two or three substances and that it varies with each of these substances. The inference which is commonly drawn that capillarity depends on the surface tension of the liquid is a mistake, because it depends also on the surrounding solid.

With regard to the foreign works on petroleum, it seems to me a little distinction should be made. I believe that students of petroleum—at least the younger ones in the United States—on going to the libraries for general treatises pull down, two times out of three,

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from the shelf something which has been written by foreign authors. That the investigations which have been carried on in the United States are of less importance I would not say at all, but it seems to me the most used and useful treatises are, as I say, of foreign authorship.

The CHAIRMAN. Time will not permit discussing these matters further. Is there any discussion of Dr. Andrade's paper?

Mr. DAY. It is a great pleasure to have heard of the good prospects for petroleum in Ecuador. We are all familiar with the oil and the oil fields there on the coast. What I feel particularly interested in is the apparently favorable attitude of the Ecuadorian Government toward investments in, and the development of, these oil fields. It is rather a surprise to me that the development has not gone on more rapidly. I would like to ask Dr. Andrade to tell what stopped the development of the Ecuadorian fields by the Dutch and other interests?

Mr. ANDRADE. The Pearson Co. in 1912 wanted to get a franchise from our Government, but they wanted too much. I understand they wanted to invest a million or a half million dollars, but they wanted us to make too many concessions. The Ecuadorian Government expected to have a better proposition, and had been expecting it from foreign governments. It seemed to me that this company, however, wanted to control two or three of the oil-producing fields. The State Department, I think, in Washington took up the matter. I do not think, however, they carried out the dealings with the Pearson people. It seems to me that occurred in 1911 or 1912. I believe a concession was granted in 1907 which extended to 1910. They were given free exportations—free without any taxes—and it was said to them at that time that the time would be extended. In 1915 the Congress of our country extended the time of free taxes on exportations for 20 years. I understand that the tax on the properties down there is only $80 a thousand acres. That is all the tax they have to pay. That covers everything. The capital invested has no tax whatever, and it does not matter whether the profits are used in the country or not.

Mr. DAY. I would like to ask if the grant is by denouncement or concession?

Mr. ANDRADE. Usually by denouncement. A great deal of the land is in the hands of private persons.

The CHAIRMAN. We will have to pass on to the next paper now. It is unfortunate that Dr. Arnold is not here in person to present it. Mr. Wegemann has agreed to present Dr. Arnold's paper on "Conservation of the oil and gas regions of the Americas." I have the great pleasure of presenting Mr. C. H. Wegemann, who will read this paper for us.

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# CONSERVATION OF THE OIL AND GAS RESOURCES OF THE AMERICAS.

By RALPH ARNOLD,

*Consulting Geologist and Petroleum Engineer, Los Angeles, Cal.*

ACKNOWLEDGMENTS.

In preparing a paper of so wide a scope as the title of this one implies it becomes necessary to seek information from first-hand sources if one wishes to make his data at all complete. The writer has been fortunate in having the hearty cooperation of many whose personal work is adding day by day to our general knowledge of the gas and oil fields of the Americas. Among those to whom he is particularly indebted are Dr. George Otis Smith, director of the United States Geological Survey; W. A. Williams, of the United States Bureau of Mines; Dr. Eugene Haanel, Dr. R. G. McConnell, and Mr. Wyatt Malcolm, of the Canadian Department of Mines; Messrs. Campbell M. Hunter, James H. Gardner, Richard Hice, D. C. Stapletan, R. E. Darke, F. E. Vassar, G. Jeffreys, V. R. Garfias, W. T. S. Doyle. J. S. McKenna, E. DeGolyer, R. W. Stone, Chester Washburne, Dr. J. C. Branner, Dr. Bailey Willis, Dr. G. D. Harris, and Prof. L. C. Glenn. Among the more important sources of written information to which the writer has referred are the publications of the United States Geological Survey; several State surveys and the Canadian Department of Mines; "Treatise on petroleum," by Sir Boverton Redwood; "Exploitation du pétrole." by L. C. Tassart; "Oil fields of western Canada," by Dr. T. O. Bosworth (Petroleum World, vol. 12, February, 1915); and reports by Dr. Anselmo Windhausen, of Buenos Aires, and others, on the oil fields of Argentina.

## INTRODUCTION.

In a recent paper [1] the writer has estimated the future available oil supply of the United States at 5,763,100,000 barrels, which, at the present rate of consumption of 265,000,000 barrels yearly, would last only 22 years. He has pointed out, however, that as the production of oil in the United States will gradually decrease from year to year the total available supply will probably spread out over a period of 50 to 75 years, and that coincident with the decrease in annual production there will be a rise in price from the present average of about 95 cents a barrel to twice or possibly five times that amount.

It is the purpose of the present paper to show the status and possibilities of the oil industry in each country of the Americas and to discuss briefly some of the ways in which the oil resources of these countries can best be conserved. Gas will be mentioned only as it is incidental to the oil.

Before beginning the discussion, it will be well to enumerate some of the factors that govern the production of oil and gas in all countries. These factors may be divided into two groups—natural factors and artificial factors. In the group of natural factors are rock pressure, or pressure under which the oil and gas exist in their underground reservoir; viscosity of the oil; and thickness, extent, porosity, and structure of the reservoir rock. In the group of artificial factors are the price of oil or gas, which is the dominant factor, and such others as depth of wells, time required to complete wells, distance separating wells, conditions of wells, pumps and other equipment, improvement in methods of

[1] Arnold, Ralph, Petroleum Resources of the United States: Econ. Geology, vol. x, pp. 695–712, 1915.

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development and recovery, water complications, discovery of new fields, distance of fields from markets, and relative cost of production in the several fields. These conditions have all been briefly discussed in the paper cited at the beginning of this section.

The relative rank as oil producers of the countries of the Americas with respect to one another and to the countries of other continents is shown by the following table compiled by Anna B. Coons under the supervision of J. D. Northrop, of the United States Geological Survey, giving the production of crude petroleum in 1914 and from 1859 to 1914, in barrels:

TABLE 1.—*World's production of crude petroleum in 1914, and from 1859 to 1914, with percentage of production, by countries, in barrels of 42 gallons.*

| Country. | 1914. | | 1859–1914. | |
|---|---|---|---|---|
| | Production. | Per cent. | Production. | Per cent. |
| 1. United States | 265,752,535 | 66.36 | 3,335,457,140 | 59.63 |
| 2. Russia | 67,020,522 | 16.74 | 1,622,233,345 | 29.00 |
| 3. Mexico | 21,188,427 | 5.29 | 90,359,369 | 1.62 |
| 4. Roumania | 12,826,579 | 3.20 | 117,982,474 | 2.11 |
| 5. Dutch East Indies | [1] 12,705,208 | 3.17 | 138,278,392 | 2.47 |
| 6. India | [2] 8,000,000 | 2.00 | 73,979,019 | 1.32 |
| 7. Galicia | [2] 5,033,350 | 1.26 | 131,873,001 | 2.36 |
| 8. Japan | [3] 2,738,378 | .68 | 27,051,158 | .48 |
| 9. Peru | 1,917,802 | .48 | 14,306,972 | .26 |
| 10. Germany | [2] 995,764 | .25 | 12,965,569 | .23 |
| 11. Egypt | 777,038 | .19 | 1,086,728 | .02 |
| 12. Trinidad | 643,533 | .16 | 2,069,430 | .04 |
| 13. Argentina | 600,000 | .15 | 600,000 | .01½ |
| 14. Canada | 214,805 | .05 | 23,493,010 | .42 |
| 15. Italy | 39,548 | .01 | 802,229 | .01 |
| 16. Other countries | 20,000 | .01 | 722,000 | .01½ |
| | 400,483,489 | 100.00 | 5,593,262,936 | 100.00 |

[1] Includes British Borneo. [2] Estimated. [3] Includes Formosa.

As nearly three-fourths of the world's supply comes from North and South America, the tremendous influence they wield in this great industry is obvious, and in view of the fact that petroleum is a fundamental necessity of modern civilization, the strength of the New World's position becomes manifest. The countries of North and South America now hold relative positions in this industry indicated by the following order: United States, Mexico, Peru, Trinidad, Argentina, Canada, Venezuela, Colombia, Bolivia, and Ecuador.

### OIL FIELDS OF NORTH AMERICA.

Indications of petroleum are found in most of the countries of North America. The United States and Mexico are the largest producers, and Canada yields a small amount, but the other countries are nonproductive at present.

### NEWFOUNDLAND.

Petroleum was first discovered in Newfoundland in 1812, but no effort was made to develop it for over half a century. The petroleum-bearing area of Newfoundland is confined to its west coast, the principal localities, according to Redwood, being at Port au Port Bay and from Bonne Bay to Sandy Bay. The reservoir rocks are the porous Lauzon limestones and Levis sandstones of the Quebec group, of Ordovician age. The oil is of brown color, light gravity,

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and paraffin base and ranges from 36° to about 46° Baumé (0.843 to 0.798 specific gravity). Development has consisted in the sinking of four or five wells at Parsons Pond, 100 miles northeast of Port au Port Bay. The deepest well attained a depth of 1,500 feet but found only a fair showing of oil. Other wells put down at Port au Port Bay yielded small quantities of a light paraffin-base oil. No commercially important deposits of petroleum are believed to exist in this island.

### CANADIAN OIL FIELDS.

*General features.*—The oil-producing territory of Canada is confined at present to the Province of Ontario, where an area of about 25 square miles of proved land yields the total annual output of a little over 200,000 barrels of oil. Extensive areas in western Canada offer indications suggesting the presence of oil in commercial quantities, and it is believed that the future will see the Dominion take its place as an important producer of petroleum. The oil-yielding formations are of Ordovician to Carboniferous age in the east and of Cambrian, Devonian, and Cretaceous age in the west. The oil is usually found in sandstones, limestones, or dolomites, associated with anticlines and domes. It ranges from the heavy oil of asphaltic type in Athabasca to the high grade refining oils of 36 to 46° Baumé (0.8434 to 0.7955 specific gravity) of the Ontario field. The initial production of individual wells has never gone above 7,500 barrels daily; the present average per well is only a few gallons. The product is used entirely within the country.

*Nova Scotia.*—Oil seepages occur in the Carboniferous shale and sandstone around Lake Ainslie, on Cape Breton Island, in Nova Scotia, but shallow borings made here have not been rewarded by production. This evidence and the paucity of indications elsewhere in the Province leads to the conclusion that it will never yield oil in commercial amounts.

*New Brunswick.*—The proved oil territory of New Brunswick occupies an area of about 2½ square miles. It lies on the west bank of Petitcodiac River, between Stony Creek and Weldon Creek in Albert County. The oil occurs in sandstone beds, which are possibly in the nature of lenses in the shales of the Albert series of the Carboniferous system. The oil has a paraffin base, is free from sulphur, and ranges in gravity from 32 to 37° Baumé (0.862 to 0.838 specific gravity). The production of the wells is small. Considerable quantities of gas accompany the oil. Indications of petroleum have also been found along anticlines in Kings and Westmoreland Counties. To judge by the results of drilling in this Province it does not seem probable that large deposits of petroleum will be found here.

*Quebec.*—Discoveries of gas in commercial quantities and indications of petroleum have stimulated prospecting in Quebec over a long period of time. Gas is found at St. Hyacinthe, St. Gregoire, Beausejour, and in insignificant quantities elsewhere. Evidences of petroleum occur on the Saguenay, Dartsmouth, York, St. John, and Malbey Rivers. The area chiefly explored lies in the basin of the York River as far west as Falls Brook. The hydrocarbons are found at one place or another through the entire geologic series from the Trenton limestone (Ordovician) to the lower Devonian, but the upper formations yield the most favorable evidences for commercial deposits. The oil indications are usually associated with anticlinal structure. The oil is mostly of high grade, ranging between 18 and 46° Baumé (0.948 to 0.795 specific gravity). Development has been carried on intermittently for a period of over 40 years in the Gaspé field, but no uniformly commercially successful

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results have been realized, although some deep wells have been sunk. It does not appear probable that the Province will ever yield more than very small quantities of oil.

*Ontario.*—The petroliferous fields of Ontario, the most important oil-producing Province of Canada up to the present time, form a northeastward continuation of the Ohio-Indiana field of the United States. The producing oil fields are limited to that section of the Province lying south of a line drawn from the west end of Lake Ontario to the foot of Lake Huron, and most of the oil produced comes from Lambton, Kent, Elgin, and Brant Counties. The Oil Springs pool covers 2 square miles, and the Petroleo field covers 26 square miles. None of the others cover more than a few square miles, and the total proved area of the district probably does not exceed 50 square miles. The formations yielding oil and gas range from the Trenton (Ordovician) to the Chemung group (Devonian). The chief source of oil is the Onondaga limestone of the Devonian, and the principal deposits of gas are found in the Medina sandstones and Trenton limestone. The Tilbury field derives its oil from the Salina formation and Guelph dolomite of the Silurian. The rocks as a rule are nearly horizontal and are covered by a great thickness of drift. Domes are the principal structural features affecting accumulation in these fields, although locally porous lenses or pockets and crevices afford sites for commercial deposits of oil. The wells range in depth between 300 and 500 feet, and in production from an individual initial yield of 7,500 barrels daily, in one of the wells drilled in the sixties, down to the average of a fraction of a barrel a day now maintained by the wells of the district. The Ontario petroleums are rich in lubricating oils and give good yields of paraffin; those of Lambton County run as high as 2½ per cent in sulphur. The Lambton County oils range in gravity from 31° to 35° Baumé (0.8696 to 0.8485 specific gravity); those of Tilbury from 38° to 41° Baumé (0.8333 to 0.8187 specific gravity). The relative importance of the Ontario pools is shown in the following figures of production furnished by Mr. Wyatt Malcolm, of the Canadian geological survey:

TABLE 2.—*Production of petroleum in Ontario.*

| County. | 1906. | 1910. | 1914. |
|---|---|---|---|
| Lambton County | 377,286 | 205,456 | 154,186 |
| Bothwell Field | 44,527 | 36,998 | 33,961 |
| Tilbury and Romney | 106,992 | 63,058 | 18,590 |
| Dutton | 19,376 | 7,752 | 2,190 |
| Onondaga | ..... | 1,005 | 2,437 |

There are a few other fields of small yield, and a few that have produced small quantities of petroleum, but are now exhausted. The total production of Canada in 1914 was 214,805 barrels, practically all of which came from Ontario.

In view of the facts that all of the favorable localities in the Ontario field have been pretty thoroughly prospected and that the decline of the present pools suggests that the production will sink to rather insignificant quantities within a comparatively short time, it is evident that this Province, like all of the others in eastern Canada, is destined to play but a very minor part in the oil industry of the future.

*Calgary or Foothill field.*—The Calgary or Foothill field received more attention and gained more notoriety during 1914 than any other oil region in North America. It includes the narrow belt of sharply folded and faulted Cretaceous rocks that extends for 500 miles northwestward along the eastern foot of the

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Rocky Mountains from the international boundary into northeastern British Columbia, and the parallel wider belt of low, broad domes and folds, also developed in the Cretaceous rocks, in the plains country of southern Alberta and Saskatchewan. Oil has been found in noteworthy, if not yet commercially remunerative, quantities in shale formations above the Dakota sandstone along the crests of sharply folded anticlines in the narrow belt near Calgary, and gas is being recovered in commercial quantities from beds at practically the same horizons in the broader folds in the plains region about Medicine Hat. The oil from the Calgary wells ranges from 38 to 62° Baumé (0.8333 to 0.7290 specific gravity), and the highest-grade oil is a very unusual natural product. The output of the few wells that have struck oil in the Calgary region has not yet been thoroughly tested, as the best wells have produced only a few hundred barrels in all. It is the writer's opinion that the area of commercial productivity will be confined to a few square miles along the crests of locally favorable anticlines and that the product, though small in quantity for individual wells, will for the most part be an oil of unusually high grade.

*Athabasca or Tar Sand field.*—The Athabasca or Tar Sand field includes the area in northern Alberta extending from a locality a short distance north of Edmonton to the lower reaches of Athabasca River. Throughout portions of this region Devonian limestone is unconformably overlain by asphalt-saturated sands or tar sands of Cretaceous age. These sands are in places as much as 200 feet thick, and, according to Bosworth, cover an area of at least 2,000 and possibly 10,000 square miles. If uniformly saturated, they would contain 200,000 million tons of oil, enough to satisfy the world's demand at the present rate for 2,000 years. A few wells, one at least 1,750 feet deep, have been put down in the Tar Sand region, and considerable gas and a little oil have been recovered. The oil is black and viscous and yields unusual percentages of gasoline, kerosene, and lubricants for its relative specific gravity. Owing to the poor transportation facilities and the rather unfavorable structural conditions for the accumulation of oil in the localities so far examined, little will probably be done toward the immediate development of this region, but as a potential source of hydrocarbons it must certainly be taken into account. Those who are best acquainted with it are the most enthusiastic over its possibilities.

*Northwest Territories.*—According to Bosworth, the region between Peace and Athabasca Rivers and the Arctic Ocean, covering 200,000 square miles, is occupied largely by Devonian limestones and shales, which at many points yield direct evidences of petroleum in the form of seepages, burnt shale, etc. The structure is locally favorable for the accumulation of oil, broad anticlines prevailing over extensive areas. The oil is apparently of light gravity and excellent quality. No wells have yet been drilled in the region to test its commercial possibilities, and although it is at present isolated from the markets of the world by hundreds of miles of trackless wilderness, it must, like the Tar Sand field to the south, be regarded as a possible source of future supply of oil for North America.

*British Columbia.*—The British Columbia or Rocky Mountain field, as at present known, occupies the extreme southeast corner of British Columbia and the extreme southern part of Alberta, and extends across the international boundary into Montana. The region is that of the great overthrust fault which has forced the mountain-making mass of Cambrian rocks out over the Cretaceous strata of the plains province. On Sage Creek and other adjacent tributaries of Flathead River on the west and on Pincher Creek on the east well-defined anticlines in the Cambrian beds yield seepages of a light oil, and wells drilled at both localities have produced petroleum of approximately 40°



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Baumé (0.8235 specific gravity). The oil from Sage Creek is of a peculiar milky color and an unusual composition for a natural oil and supports the theory that it has been derived by filtration from the Cretaceous beds underlying the Cambrian in the area of the thrust fault. It is the writer's belief, from personal examination, that not more than 4 or 5 square miles of this field, at the most, may prove productive and that this area will be made commercially productive only by the most careful management.

### UNITED STATES.

*General conditions.*—The oil fields of the United States are fairly well distributed geographically, occupying areas from the Appalachian Range on the east to California on the west and from the Canadian boundary on the north to the Mexican line on the south. They are usually classified as the Appalachian, Lima-Indiana, Illinois, Mid-Continent, Gulf, Rocky Mountain, California, and Alaska fields. Their proved area includes over 4,100 square miles; the prospective territory nearly 1,000 square miles. The total production to 1914 was 3,335,457,130 barrels; the estimated future supply is 5,763,100,000 barrels. The oil is found in formations ranging in age from the Ordovician to the latest Tertiary and Quaternary, usually in sandstones or limestones. Practically all types of structure are present in the productive areas, but anticlines and domes predominate.

In quality the oil ranges from the asphalt-base oils of California and Texas whose gravity is from 10° to 35° Baumé (1.000 to 0.8485 specific gravity), to the lightest paraffin-base oils of the Eastern States, whose gravity is from 25° to 52° Baumé (0.9032 to 0.7692 specific gravity). The maximum production for most of the wells is 10,000 barrels daily, although there have been daily records of 58,000 barrels in California and 75,000 barrels in Texas. The wells range in depth from 200 to more than 6,000 feet. Oil pipe-line transportation systems extend for hundreds of miles in certain parts of the country.

At the present rate of consumption—about 265,000,000 barrels a year—the estimated supply of 5,763,100,000 barrels would last only 22 years. However, as has been pointed out, the production of oil in the United States will gradually decrease from year to year, and it is therefore believed that the total available supply will last for a period of 50 to 75 years. The price of oil, which now ranges from 40 cents to $2 a barrel (average, 95 cents), depending on the locality and grade, probably will increase to figures approximating $1 a barrel for fuel oil and possibly $5 or more for oil of the lighter grades. All other factors being equal, a barrel of fuel oil compared with coal is worth to-day 93 cents on the Pacific coast. Even were oil to be used only as a fuel the tendency would be for it to rise in price until it reached a point set by the value of coal in the same regions. Because of the ease of handling, cleanliness, and other points in favor of oil there is no doubt that eventually it will be sold at a higher price than would be warranted by its heat value compared with that of coal.

Before the free natural petroleum in the earth is exhausted a beginning will have been made in utilizing the oil shales of Colorado, Utah, California, and other States as a source of petroleum, and artificial oil made from animal and vegetable waste will probably also be available to take its place. Even at the present time the necessities of war have led certain of the European Governments to utilize various substitutes for petroleum and its derivatives, the substitutes in general being made from organic substances.

The relative rank of the States is shown in the following table, which gives the marketed production for the year 1914, and the total from 1859 to 1914:

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TABLE 3.—*Production of petroleum in the United States for 1914 and from 1859 to 1914, in barrels.*[1]

| | 1914 | 1859 to 1914 | | 1914. | 1859 to 1914. |
|---|---|---|---|---|---|
| California | 99,775,327 | 741,273,559 | New York | 938,974 | (2) |
| Oklahoma | 73,631,724 | 435,478,958 | Kentucky | 502,441 | [3]9,095,970 |
| Illinois | 21,919,749 | 232,326,616 | Colorado | 222,773 | 10,649,143 |
| Texas | 20,068,184 | 203,799,381 | Alaska | (4) | (5) |
| Louisiana | 14,309,435 | 89,895,433 | Michigan | (4) | (6) |
| West Virginia | 9,680,032 | 260,232,815 | Missouri | (4) | 72,712 |
| Ohio | 8,536,352 | 432,762,004 | New Mexico | ..... | (6) |
| Pennsylvania | 8,170,335 | [6]754,180,213 | Other States | 7,792 | ..... |
| Wyoming | 3,560,375 | 7,964,944 | | 265,762,535 | 3,335,457,140 |
| Kansas | 3,103,585 | 54,901,592 | | | |
| Indiana | 1,335,456 | 102,823,800 | | | |

[1] From figures compiled by the United States Geological Survey.
[2] Included in "Pennsylvania."
[3] Includes Tennessee.
[4] Included in "Other States."
[5] Included in "Missouri."
[6] Includes New York.

*Appalachian field.*—The Appalachian field extends from southwestern New York through western Pennsylvania, southeastern Ohio, West Virginia, and eastern Kentucky into northern Tennessee. The proved area is 1,965 square miles; the prospective area, 260 square miles. The production of the field for 1914 was 24,101,048 barrels. The total production to 1914 was 1,266,051,461 barrels; the probable future production is 464,000,000 barrels; and the field is therefore 73 per cent exhausted. The formations yielding the oil throughout this field are of Devonian and Carboniferous age. The oil occurs along the axes and on the flanks of anticlines, parallel in general with the strike of the Appalachian Mountains, and on minor terraces or other structural features associated with the anticlines. Here and there it has been found in waterless synclines. The reservoir rocks are principally sandstones and coarse sediments. The oil from this field is of the best quality in the world, yielding a high percentage of the lighter oils such as gasoline and kerosene, and is utilized entirely for refining. It is of paraffin base and ranges in gravity from 25° Baumé (0.9032 to 0.7778 specific gravity); the heavier grades come only from the south end of the field. The price of "Pennsylvania grade" oil is always high, reaching $2.50 a barrel. The average daily production of the wells is low, being 0.2 to 0.4 barrel in 1911. This field is almost completely developed except the portions in Kentucky and Tennessee, and even here late prospecting has resulted only in negative results in a majority of tests.

*Lima-Indiana field.*—The Lima-Indiana field covers a considerable portion of northwestern Ohio and eastern Indiana. The proved area covers 1,035 square miles; the prospective area, 140 square miles. The production of the field for 1914 was 5,062,543 barrels. The total production of the field to 1914 was 293,043,331 barrels; the estimated future production is 113,000,000 barrels; and the field is therefore about 72 per cent exhausted. The oil is derived from rocks of Ordovician, Silurian, and Carboniferous age, largely from the Trenton limestone, the reservoir rocks being porous dolomitic lenses or beds or sandstones. Favorable structures, such as half domes and terraces, on the flanks of the Cincinnati uplift usually harbor the commercial deposits. The oil is of paraffin base, ranges in gravity from 30 to 35° Baumé (0.8750 to 0.8484 specific gravity), carries a little sulphur, and is utilized entirely for refining. The average initial daily production of the wells up to 1911 was 15.5 barrels; the average daily production per well for that year was 0.7 barrels. This field also is almost completely outlined, although new pools are being discovered occasionally.

*Illinois field.*—The Illinois field occupies a strip of territory along the La Salle anticline, in the southeastern part of the State, and extends a short distance into Indiana. The proved area of the field is 400 square miles; the prospective

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area 100 square miles. The production of the field for 1914 was 21,919,749 barrels. The total production of the field to 1914 was 232,326,616 barrels; its estimated future supply is 400,000,000 barrels; and the field is, therefore, about 36 per cent exhausted. The oil is derived largely from Pennsylvanian rocks and in part from upper Mississippian rocks (both Carboniferous). It occurs principally in well-defined sandstone beds along the crest of the unsymmetrical La Salle anticline. Impregnation is governed locally by the lithologic character of the reservoir rock. A little of the oil comes from limestone. The oil is of paraffin base, although locally carrying some asphalt. It ranges in gravity from 28 to 39° Baumé (0.8860 to 0.8284 specific gravity), and is used principally for refining. The average initial daily production up to 1911 was 63 barrels; the average daily production of the individual wells for the same year was 4.2 barrels. With the exception of some possible territory in the western part of the State, the Illinois productive area is well defined at the present time.

*Mid-Continent field.*—The Mid-Continent field comprises the pools in Oklahoma, southeastern Kansas, and northern Texas. The proved area of this field is about 377 square miles; the prospective area 203 square miles. The production of the field for 1914 was 97,995,400 barrels. The total production to 1914 was 494,179,921 barrels; the estimated future production is 1,852,000,000 barrels; and the field is, therefore, about 28 per cent exhausted. The oil is obtained from the sandstones of the Pennsylvanian (Carboniferous) formations in domes, half domes, or terraces, and local anticlines on the flanks of the great Ozark uplift. The oil is of paraffin base, ranges in gravity from 27 to 41° Baumé (0.8917 to 0.8187 specific gravity), and is used for refining. It is piped to the Gulf and also to Indiana and other Eastern States. The development in this field has been rapid during the last few years, some of the pools being highly productive. The average initial daily production of the wells in 1911 was 119 barrels; the average daily production, 8.6 barrels. A considerable percentage of this field yet remains to be prospected, the bulk of the untested land lying in Texas.

*Gulf field.*—The Gulf field includes the pools lying along the coastal plain of Louisiana and Texas. The proved area in this field is about 127 square miles; the prospective area 90 square miles. The production of the field for 1914 was 13,117,528 barrels. The total production to 1914 was 289,895,433 barrels; the estimated future production is 303,000,000 barrels; and the field is therefore about 48 per cent exhausted. The oil occurs for the most part in domes, associated with deposits of salt and gypsum. The age of the containing rocks ranges from Cretaceous to Quaternary. The reservoir rock is usually porous dolomitic limestone or sandstone. The oil of northern Louisiana occurs in Cretaceous and Eocene rocks along an uplift or fold. The oils of the Gulf field vary greatly in composition; those in the strictly coastal belt range from 15 to 27.7° Baumé (0.9655 to 0.8878 specific gravity) and are of asphalt base; those of northern Louisiana range from 25 to 43.6° Baumé (0.9031 to 0.8065 specific gravity), and are of paraffin base. Sulphur usually accompanies the heavy oil. The lighter oils are used for refining, the heavier oil for fuel. Some of the individual wells have been very productive, a daily flow of 75,000 barrels being recorded for at least one well. Most of the pools are rather short lived. In 1911 the average initial daily flow for the Gulf coastal pools was 257 barrels, and for northern Louisiana 1,176 barrels; the daily average for the field 60 barrels. Some territory still remains untested in this field.

*Rocky Mountain field.*—The Rocky Mountain field embaces pools in Wyoming and Colorado and untested deposits in Utah and New Mexico. The proved area in this field is about 48 square miles, the prospective area about 55 square

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miles. The production of the field for 1914 was 3,783,148 barrels. The total production to 1914 was 18,614,087 barrels, the estimated future supply is 321,000,000 barrels, and the field is therefore about 6 per cent exhausted. The oil occurs in beds of Carboniferous, Triassic (?), and Cretaceous age, as a rule in sandstone interbedded with shale, though locally in fracture zones. Typical dome structure affords the most favorably locations, but a few commercial deposits occur in monoclines or interrupted monoclines. The oils from the older formations range in gravity from 18 to 24° Baumé (0.9459 to 0.9091 specific gravity), are of asphalt base, and are used largely for fuel; those from the Cretaceous beds range from 32 to 48° Baumé (0.8642 to 0.7865 specific gravity), are of paraffin base, and are refined, yielding high percentages of gasoline, kerosene, and distillates. The productivity of individual wells usually is not large, the average daily yield being about 25 barrels in 1913. The potentialities of the Rocky Mountain field are not great unless the extensive deposits of oil shale in northwestern Colorado and northeastern Utah are taken into account. As these deposits will require a distillation process for the recovery of their oil contents, they are not included under the head of free-oil deposits.

*California field.*—California produces more petroleum than any other State in the Union. The oil is derived from rocks of Cretaceous to late Tertiary age, the great bulk coming from the Miocene. Nearly every type of structure peculiar to the coast ranges yields commercial quantities of oil, anticlines, domes, plunging anticlines, monoclines, and fault zones being the principal sources. The reservoir rocks are usually sand and sandstone, though fracture joints in shale carry oil in at least one district. The oil is practically all of asphalt base, although paraffin in quantities up to 4 per cent is found in a little of the oil from the Cretaceous and Eocene rocks. The oil ranges in gravity from 12 to 35° Baumé (0.9859 to 0.8484 specific gravity), and about 70 per cent of it is topped or refined. Much of the heavy oil is used for fuel and road dressing. The proved area in this field is 156 square miles; the prospective area 40 square miles. The production of the field for 1914 was 99,775,327 barrels. The total production of the field to 1914 was 741,273,559 barrels; the estimated future production is 2,300,000,000 barrels; and the field is therefore about 24 per cent exhausted. The productivity of individual wells has reached 58,000 barrels daily; the average daily production was 45.2 barrels in 1913. The oil districts of California are practically outlined to-day, and little in the way of additional acreage is to be expected in the future.

*Alaska field.*—Small quantities of oil have been obtained from the Jurassic rocks of western Alaska and the early Tertiary rocks of eastern Alaska. The oil occurs in sandstone along well-defined anticlines, some of which are faulted. It ranges in gravity from 39 to 45.9° Baumé (0.8260 to 0.7958 specific gravity) and is of an excellent refining grade. The wells so far drilled are small producers. About 15 square miles of territory is known to carry some favorable indications of petroleum, but the commercial productivity of the Alaskan deposits remains to be proved.

*Other fields.*—In addition to the deposits in the States, included in the above-mentioned fields, oil occurs in small quantities in Michigan (a continuation of the Petroleo field of Canada) and in Missouri (a continuation of the Oklahoma field). These States and Alaska together produced only 7,792 barrels in 1914. Alabama and Mississippi also are said to show possibilities of oil.

*Summary table of the States.*—The following table summarizes the principal points regarding the oil-producing States:

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TABLE 4.—*Past and estimated future production of petroleum in the United States.*

| State. | Age of containing rocks. | Base. | Quality of oil. | Production for 1914. | Total production, including 1914. | Probable future supply. | Proved area. | Prospective area. | Average production per acre. | Per cent of exhaustion. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | *Barrels.* | *Barrels.* | *Barrels.* | *Square miles.* | *Square miles.* | *Barrels.* | |
| Alaska | East, Lower Tertiary; west, Jurassic | Paraffin | 39–45.9 B.<br>0.8284–0.7958 | ..... | ..... | 10,000,000 | ..... | 15 | 1,000 | 0 |
| California | Cretaceous and Tertiary | Asphalt | 12–35 B.<br>0.9859–0.8484 | 99,775,327 | 741,273,559 | 2,300,000,000 | 156 | 40 | 30,000 | 24 |
| Colorado | Pierre (Cretaceous) | Paraffin | 38–44 B.<br>0.8333–0.8045 | 222,773 | 10,649,143 | 21,000,000 | 17 | 33 | 1,000 | 33⅓ |
| Illinois | Mississippian and Pennsylvanian | do | 28–39 B.<br>0.8860–0.8284 | 21,919,749 | 232,326,616 | 400,000,000 | 400 | 100 | 2,500 | 36+ |
| Indiana | East, Ordovician (Trenton); west, Pennsylvanian. | do | 30–35 B.<br>0.8750–0.8484 | 1,335,456 | 102,823,798 | 20,000,000 | 500 | 100 | 400 | 83+ |
| Kansas | Pennsylvanian | Paraffin and asphalt | 27–38 B.<br>0.8917–0.8333 | 3,103,585 | 28,547,074 | 40,000,000 | 70 | 30 | 1,500 | 42 |
| Kentucky and Tennessee. | Mississippian | Paraffin | 25–43 B.<br>0.9032–0.8092 | 502,441 | 9,095,970 | 10,000,000 | 100 | 100 | 300 | 47 |
| Louisiana | Cretaceous to Quaternary | do | 21–40 B.<br>0.9271–0.8187 | 14,309,435 | 89,895,433 | 170,000,000 | 87 | 40 | 4,500 | 34 |
| Michigan and Missouri | Carboniferous | do | 30 B. | 7,792 | 72,712 | 100,000 | 1 | ..... | ..... | 58 |
| New Mexico | Carboniferous to Cretaceous | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| New York and Pennsylvania. | Devonian and Carboniferous | Paraffin | 25–50 B.<br>0.9032–0.7778 | 9,109,309 | 754,180,215 | 135,000,000 | 1,400 | 100 | 1,000 | 85 |
| Ohio | Ordovician to Carboniferous | do | 35–47 B.<br>0.8484–0.7909 | 8,536,352 | 432,762,004 | 205,000,000 | 650 | 50 | 1,500 | 67 |
| Oklahoma | Pennsylvanian | do | 32–41 B.<br>0.8641–0.8187 | 73,631,724 | 461,833,466 | 1,545,000,000 | 297 | 73 | 10,000 | 22 |
| Texas | Pennsylvanian, Cretaceous to Quaternary. | Asphalt and paraffin | 15–38 B.<br>0.9655–0.8333 | 20,068,184 | 203,799,381 | 400,000,000 | 50 | 150 | 17,000 | 33+ |
| Utah | ..... | ..... | 22–40 B.<br>0.9210–0.8235 | ..... | ..... | ..... | ..... | 20 | ..... | ..... |
| West Virginia | Devonian and Carboniferous | ..... | 27–52 B.<br>0.8917–0.7692 | 9,680,033 | 260,232,815 | 207,000,000 | 350 | 50 | 2,000 | 55+ |
| Wyoming | Carboniferous to Cretaceous | Asphalt and paraffin | 18–48 B.<br>0.9459–0.7865 | 3,560,375 | 7,964,944 | 300,000,000 | 31 | 20 | 15,000 | 2 |
| | | | | 265,762,535 | 3,335,457,130 | 5,763,100,000 | 4,109 | 946 | ..... | 36 |

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## MEXICO.

*General features.*[1]—The known oil fields of Mexico are included within two great regions, both of which are segments of the Gulf coastal plain—the Tampico-Tuxpam and Tehuantepec-Tabasco regions. The Tampico-Tuxpam region is the larger and better known and consists of that part of the coastal plain tributary to and depending mostly for supplies on transportation through the ports of Tampico, in the State of Tamaulipas, and Tuxpam, in the State of Vera Cruz. It covers approximately that part of the coastal plain between Soto la Marina and Tecolutla Rivers, an area of some 20,000 square miles. It includes parts of the States of Tamaulipas, Vera Cruz, San Luis Potosi, Puebla, and Hidalgo, and embraces some 15 oil fields. The Tehuantepec-Tabasco region consists of that part of the coastal plain included in and between the valleys of the Coatzacoalcos and Grijalva Rivers and includes parts of the States of Vera Cruz, Tabasco, and Chiapas. This region embraces some four or five oil fields. A very rough estimate places the proved area in the two regions at 25 square miles; the prospective area at 500 to 1,000 square miles.

Exploration has advanced too little, and the Mexican fields are too young to justify any but approximate estimates of the proved, probable, or possible oil territory in each field, nor are such estimates of much value even for comparative purposes without a full consideration of other factors that are as yet undetermined. Inasmuch as less than 700 wells have been drilled for oil in the entire Republic up to the present time, and as almost two-thirds of the entire quantity of oil produced has come from two wells, neither of which is more than 6 years old, it would be rash indeed to give too much weight to estimates of unit areas.

The principal oil-yielding rocks in the Tampico-Tuxpam region are the Tamasopo limestone, of Cretaceous age, and the overlying San Felipe series, of Cretaceous or Eocene age. The oil in the San Felipe rocks has apparently migrated from the underlying Tamasopo through faults, fissures, and broken contact zones between sedimentary and intrusive rocks. Some oil is found in the overlying Mendez shale, of Eocene age, and the Oligocene limestones which overlie the Eocene. This oil also is evidently derived from the Tamasopo limestone. The oil-bearing rocks of the Tehuantepec-Tabasco region are true quartz sands of Miocene (?) and Pliocene age.

The Tamasopo limestone, the principal oil-yielding rock, is a massive-bedded, fossiliferous, hard, porcelainlike limestone. It is locally porous or cavernous as a result of solution. It is not dolomitic, but is somewhat siliceous. The overlying San Felipe beds are a series of alternating impure limestones and shales, in which the oil occurs to some extent in porous limestone members, but more generally, perhaps, in interstices in the shales. Many wells that are apparently finished in the San Felipe draw their major oil supply from the Tamasopo limestone through fissures. Potero No. 4 was finished in the San Felipe, but a great number of blocks of Tamasopo rock were blown out when the well came in.

The fields of the Tampico region are generally anticlinal in structure so far as is known; the San Diego, Casiano, Naranjos, Tierra Amarilla, Potrero, and Alamo fields being markedly so. The structure of the Topila, Panuco, Ebano, Chijol, and Chila Salinas fields is not determined, but it is probable that they are the result of the filling of porous beds in the San Felipe formation through

[1] This section is copied practically verbatim from statements kindly prepared for the writer by Mr. John S. McKenna, under the direction of Mr. V. R. Garfias, and by Mr. E. DeGolyer.

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fissures that extend to the Tamasopo, and that the structure is not a vital factor in the accumulation of the oil deposit. The Furbero field is structurally a laccolith or sill intruded into the Mendez shales on a preexisting anticline. The shales were metamorphosed by the intrusion and the igneous rock of the sill was subsequently altered, thus providing pore space. The oil evidently came from the Tamasopo limestone.

The oldest Mexican field dates as an important producer from 1906, the Isthmus fields from 1907, and the most productive fields from the latter part of 1910. There are almost no data to be had regarding the life of a field or of a well. Laguna No. 2 of the Ebano field came in November 7, 1906, with an initial production of 500 barrels a day. Five years later, in December, 1911, it was producing 450 barrels a day. No information is available regarding the larger wells, for the potential production so far exceeds the actual production, because of a lack of transportation facilities, that for many wells the true capacity, initial, potential, or present is unknown. The largest gauged production is that of Potrero No. 4, at some 110,000 barrels daily. Casiano No. 7 has yielded a total production to the present time of some 40,000,000 barrels, with no apparent sign of decline.

The following table shows the range in production of individual wells and the present daily production by districts:

TABLE 5.—*Range in production of individual wells and daily production by districts.*

| District. | Range in daily production per well. | Net present daily production for the district. |
|---|---|---|
| | *Barrels.* | *Barrels.* |
| Ebano | 50–5,000 | 5,000 |
| Panuco | 50–100,000 | 20,000 |
| Huasteca | 50–110,000 | 45,000 |
| Tuxpam | 50–10,000 | 10,000 |
| | | 80,000 |

The bulk of the oils at present produced commercially are heavy oils of mixed asphalt and paraffin base. The oils of the Tehuantepec-Tabasco region are the lightest, their gravity ranging from about 15° to 29° Baumé (0.964 to 0.882 specific gravity). The oils of the Tampico-Tuxpam region are somewhat heavier and fall into two general classes, the heavy oils of the Panuco River Valley fields, with gravity of nearly 10° to 14° Baumé (0.896 to 0.972 specific gravity), and the lighter oils of the Casiano, Potrero, Furbero, and other fields, with gravity of 19° to 26° Beaumé (0.940 to 0.900 specific gravity). A very high-grade oil, about 49° Baumé (0.783 specific gravity) has been discovered south of Valles, in San Luis Potosi, but revolutionary disturbances have precluded the development of this deposit up to the present time.

The oil is usually accompanied by and associated with a considerable quantity of gas, all "wet" so far as known. White estimates that 10,000,000 to 12,000,000 cubic feet of gas is produced daily by Casiano No. 7, and it is probable that a like quantity is produced at Potrero. A well in the Topila field came in last May with an estimated daily flow of 15,000,000 cubic feet of "wet" gas. The Alamo field is said to have a potential daily production of 4,000,000 to 6,000,000 cubic feet of "wet" gas.

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The depth of the producing wells of the Tampico-Tuxpam region ranges from 113 feet, in Tanhuijo well No. 1, to 4,000 feet, in San Pedro well No. 1, though most of the large producers are between 1,600 and 2,500 feet deep. Exploratory wells 3,000 to 4,000 feet deep are not uncommon, and Furbero No. 19, the deepest well in Mexico, has reached a depth of 4,640 feet. The wells of the Tehuantepec-Tabasco region are relatively shallow.

The following table summarizes information about the operating companies and wells:

TABLE 6.—*Operating companies and well data, Mexico.*

| District | Companies. | Wells producing. | Wells being drilled. | Dry holes or abandoned wells. | Idle wells. | Depth (feet). |
|---|---|---|---|---|---|---|
| Huasteca | 11 | 28 | 27 | 40 | 24 | 1,700–3,000 |
| Ebano | 1 | 5 | ..... | ..... | 22 | 1,500 |
| Tuxpam | 1 | 2 | 5 | 1 | ..... | 2,000 |
| Panuco (Topila) | 16 | [1] 23 | 11 | 9 | ..... | 2,600 |
| Panuco (Panuco) | 46 | [1] 60 | 57 | 12 | ..... | ..... |
| Panuco (other fields) | 4 | 2 | 1 | 1 | 11 | 770–4,000 |

[1] Completed.

Both the rotary hydraulic and standard cable systems of drilling are used. The former is particularly efficient and rapid in drilling through the great shale formation which overlies the oil zone; the latter is most efficient for drilling the alternating shales and limestones of the San Felipe series and the hard limestone of the Tamasopo, the producing formations. Though both systems are used for the entire completion of the wells, a combination of the two is generally regarded as most efficient and is in general use. The Canadian pole tool and Fauck systems have each been tried in this region, but, as they present no decided advantages, and it is difficult to obtain repairs, spare parts, etc., they have been abandoned.

The first and most general use for Mexican crude oil, aside from supplying oil for refining, for local trade, has been as a fuel oil. More than half the oil produced in Mexico is exported to the United States, where it is used for the most part as fuel oil. Shipments are also made to Central and South American and European ports. Considerable quantities of refined oils, including fuel oil, are exported to Great Britain. Asphalts, road oils, and similar products are exported to Canada, the United States, and Europe. The present tendency, with the increased refining facilities at Tampico and the better development of refining practice, both in Mexico and in the United States, is to top the crude oil before using it for fuel and thus save the lighter and more valuable constituents.

Several American and European financial groups interested in the petroleum industry are represented in the Mexican fields.

The Mexican Petroleum Co. (Ltd.) and its subsidiaries (Doheny interests) are at present the largest producers and best equipped as regards camps and facilities for transportation and storage. Their product is sold mostly in bulk to American companies along the Gulf States. Of late this company has undertaken to market its products in the United States and has established distributing depots at New York and on the Mississippi River not far from New Orleans.

The Aguila Oil Co. and its subsidiaries (Pearson interests) have a larger nominal production than the Mexican Petroleum Co., but are somewhat ham-

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pered by insufficient pipe-line and storage facilities. The oil is refined at their Minatitlan plant, the products being sold in Mexico and exported to Europe. This company and the Mexican Petroleum Co. furnish practically all the oil used in Mexico and the greater portion of that which is exported.

The Waters-Pierce Co. (Standard Oil) has a refinery at Tampico, where Mexican and American crude oils are treated, and producing wells in the Panuco district. This company and the Aguila control the market for refined oils in the Republic.

The Corona Oil Co. (Dutch Shell), East Coast Oil Co. (Southern Pacific), Pennsylvania Mexican Fuel Oil Co. (Standard Oil), and other concerns have strong affiliations and ample market facilities in the United States and Europe, and thus are able to dispose of their Mexican products regardless of the local market. Most of the lands controlled by these companies are located in the Panuco and Tuxpam districts.

Besides the groups just enumerated there are several independent companies that have no affiliations with any of these groups and depend on small contracts and the local market for the disposal of their products. The lands controlled by some of these companies are located in the Panuco and Huasteca districts, in comparatively small tracts, many of them scattered over large areas. The boom time for operators of this type is practically over, and the bulk of the oil industry in Mexico has passed into the hands of large financial interests.

The following figures of production of crude oil in Mexico were compiled by Miss Anna B. Coons of the United States Geological Survey:

TABLE 7.—*Production of crude oil in Mexico, 1904 to 1914.*

[In barrels of 42 gallons.]

| | | | |
|---|---|---|---|
| 1904 | 220, 658 | 1911 | 14, 051, 643 |
| 1905 | 820, 379 | 1912 | 16, 558, 215 |
| 1906 | 1, 097, 264 | 1913 | 25, 696, 291 |
| 1907 | 1, 717, 690 | 1914 | 21, 188, 427 |
| 1908 | 3, 481, 610 | | |
| 1909 | 2, 488, 742 | Total | 90, 153, 721 |
| 1910 | 3, 332, 807 | | |

*Soto la Marina field.*—The northernmost oil field in Mexico takes its name from Soto la Marina River. It is in the State of Tamaulipas, 15 to 20 miles from the coast and 100 miles north of Tampico. The oil in this field is found in the porous limestone of the San Felipe series (Cretaceous and Eocene). Some oil may occur under laccoliths or lava flows above the main producing horizon. No well-defined structure other than the easterly monoclinal dip is observed in the field, the dominant structural factors of accumulation being basalt intrusions, laccoliths, and faults. The oil averages about 18° Baumé (0.9459 specific gravity). Two wells are now being drilled in this field and have attained a depth of 3,000 feet, but oil in commercial quantities has not yet been encountered.

*Tamasi field.*—The Tamasi field includes all the more or less prospective areas between Los Esteros, on the Mexican Gulf Railroad, and the valley of Tamasi River, 20 to 30 miles northwest of Tampico. The oil comes from fracture zones in the lower Mendez marl (Eocene) and limestones in the San Felipe formation (Cretaceous and Eocene). Toward the northwestern part of the field anticlines appear to play an important part in the accumulation of the oil, but the southeastern part is more probably affected by fracturing and faulting. The oil is very heavy, ranging from 10° to 14° Baumé (1.000 to

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0.9722 specific gravity). The production of the wells is so small and the oil so heavy that it is commercially worthless under existing marketing conditions.

*Ebano field.*—The Ebano is the oldest of the fuel-oil fields and is on the Mexican Central Railway 40 miles west of Tampico. It includes about 4 square miles of proved ground; the few tests so far made outside of the producing area have not proved successful. The oil comes from the limestone and fracture zones in the San Felipe (Cretaceous and Eocene), the accumulations being largely determined by volcanic necks and fault zones. The oil ranges in gravity from 10° to 14° Baumé (1.000 to 0.9722 specific gravity). Wells yielding as much as 5,000 barrels a day have been recorded in the field; but the settled production runs from 25 to 5,000 barrels daily per well. La Paz No. 1 has averaged 1,500 barrels daily since April, 1904. The wells range in depth from 1,500 to more than 2,000 feet. The oil has been used principally for fuel on the railroads and for the manufacture of asphalt.

*Panuco-Topila field.*—The most important of the northern fields is the Panuco-Topila, which extends along Panuco River from 20 to 30 miles west of Tampico. The proved area embraces about 4 square miles; the possible territory includes at least 10 square miles. The oil is obtained in the San Felipe (Cretaceous and Eocene) but probably comes from the underlying Tamasopo limestone (Cretaceous) through fissures. The range in gravity is 10° to 14° Baumé (1,000 to 0.9722 specific gravity). An initial flow of over 100,000 barrels daily has been recorded for one well; the settled production ranges from 50 to 100,000 barrels daily. The average daily production per well for the wells now being operated in the field is about 250 barrels. The wells range in depth from 1,800 to 2,600 feet. The oil is all marketed through Tampico and is used largely for fuel and the manufacture of asphalt. On account of its great viscosity, which renders pipe-line transportation unsatisfactory, the oil is sent down the river in barges. Transportation is the factor at present governing the production of this field.

*Valles (San Pedro) field.*—The small Valles, or San Pedro, field lies in the belt of Tertiary rocks 80 miles west-southwest of Tampico. The proved area includes a quarter of a square mile, the possible territory 1 to 2 square miles. The oil comes from the crest of an anticline in alternating limestones and shales of the San Felipe (Cretaceous). It averages about 48° Baumé (0.785 specific gravity and is light colored and extremely volatile. The daily production of individual wells ranges from 50 barrels initial to 10 barrels settled. The wells are about 4,000 feet in depth.

*Huasteca district.*—All the fields lying between the valleys of Panuco and Tuxpam Rivers, southwest of Tampico, among which are the Tankuijo, Tierra Amarilla, Juan Casiano, Cerro Azul, Potrero del Llano, and Los Naranjos fields, are included in the Huasteca district. This district occupies a belt about 80 miles in length and 30 miles in average width, or a total area of 2,500 square miles. The proved areas include about 15 square miles; the possible territory at least 500 square miles. The oil is obtained from beds at various horizons from the Tamasopo limestone (Cretaceous) to the Tuxpam impure limestones and sands (Miocene). The enormous producers, all of which yield medium-grade oil of 19° Baumé (0.9395 specific gravity), obtain oil from the porous and cavernous limestones at the lower horizons. The sandstones and limestones at the upper horizons yield smaller quantities of a higher-grade oil—26 to 29° Baumé (0.8974 to 0.8805 specific gravity). Broad anticlines with numerous faults and igneous intrusions of various types appear to dominate the commercial accumulations. The initial production of individual wells yielding the medium-grade oils reaches 110,000 barrels a day, the capacity for settled controlled production ranges from 50 to 110,000 barrels daily, and the

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average daily production is at least 1,600 barrels per well. The production of the wells yielding high-grade oil ranges from 300 barrels initial down to 25 barrels settled. The oil is marketed through Tampico and Tuxpam and is used principally for fuel, with minor quantities being refined. The wells tapping the upper (Tertiary) beds range in depth from 100 to 500 feet; those reaching the lower horizon from 1,800 to 2,500 feet.

*South Tuxpam field.*—The South Tuxpam field includes the areas south of Tuxpam River, such as Furbero and Alamo, covering about 800 square miles. The proved territory is less than 1 square mile, the prospective territory about 50 square miles. The oil at Alamo comes from the Tamasopo (Cretaceous) limestones, probably in an anticline, and that at Furbero from Eocene marls associated with a laccolith or sill. The oil ranges from 18 to 26° Baumé (0.9459 to 0.8974 specific gravity). The range in individual daily production is from 20,000 barrels initial (Alamo) to less than 100 barrels settled (Furbero). The wells are from 1,700 to 2,500 feet deep. The oil is marketed at Tuxpam for fuel and refining.

*San Cristobal field.*—The San Cristobal field is about 40 miles inland from Coatzacoalcos, in the Isthmus of Tehuantepec, and includes some subsidiary fields, such as Jaltipan. Its real extent is about 20 by 5 miles, or 100 square miles. The proved area is less than 1 square mile; the prospective area is rather small. The oil-yielding rocks are lower to middle Tertiary sandstones; the dominant structures are well-defined elongated domes. The oil ranges in gravity from 25 to 32° Baumé (0.9032 to 0.8642 specific gravity). The individual daily production runs from 500 barrels initial to 50 barrels settled; an average at the present time is about 50 barrels. The market for the oil is the Minatitlan refinery. The wells are from 300 to 1,000 feet in depth.

*Macuspana-Chiapas field.*—The Macuspana Chiapas field includes areas in south-central Tabasco to the borders of Chiapas. The petroliferous territory includes about 20 square miles, of which about a quarter of a square mile is proved. The oil comes from middle and upper Teritiary sandstones in monoclinal and anticlinal structure. The range in gravity of the oil is 30 to 40° Baumé (0.8750 to 0.8235 specific gravity); the average daily production is about 10 barrels to the well. Little of the oil has been marketed, and the field is temporarily idle. The wells range in depth from 100 to 2,000 feet.

*Campeche field.*—Recent test drilling at Rancho el Chapopote revealed promising indications of an oil field near Campeche, in the State of Campeche.

*Conclusions.*—No one can read even the most moderate statement regarding the Mexican oil fields without being impressed by their wonderful potentiality. There are a dozen wells in Mexico which, if opened to their full capacity, could almost double the daily output of the world. Political disturbances and difficulties of transportation have governed the production in Mexico since the large wells were brought in, so that no adequate estimate of total capacity can be made. It is certain, however, that the Mexican fields are destined to control the fuel situation on this side of the Atlantic Ocean for a long time to come, and that it is simply a question of transportation facilities and markets that will determine whether these fields are to produce as much or more than the combined fields of the United States. As to the longevity of the wells, no one can predict with certainty. When a well or group of wells begins to drop in production its decline will probably be rapid, for all the evidence in hand leads to the conclusion that water surrounds and underlies the productive areas and zones, and when the oil is gone from any reservoir the incoming water will terminate its productivity forever.

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### CENTRAL AMERICA.

Little is known of the oil possibilities of the Central American countries, but from the information available it does not seem probable that any commercially important fields will ever be developed in them. Certain regions showing surface evidences of petroleum have been examined by private interests, but little or no effort has been put forth by the Governments themselves to explore or exploit their oil resources.

*Guatemala.*—The oil-bearing formations of Chiapas and Campeche extend southeastward into eastern Guatemala, where they are said to yield indications of petroleum, especially near the Mexican boundary. The only exploratory work so far carried on has been done by the International Railroad of Central America, which has developed a small production for its own use.

*Honduras.*—Good seepages of oil are reported as occurring in limestone (presumably of Cretaceous age) near Camayagua, in the Guare Mountains, Honduras. Indications are also said to exist at points along the Caribbean coastal plain. No development, so far as known, has been attempted.

*Costa Rica.*—Seepages of oil are known along the east coast of Costa Rica, and efforts to secure concessions have been made at one time or another in the past. No detailed examinations and no development work have been attempted, so that the possibilities of the country are at present unknown.

*Panama.*—Seepages of oil occur at San Miguel Bay, on the Pacific side of the Isthmus of Panama, 50 to 60 miles northwest of the Colombian boundary. They are probably in northward extensions of the oil-bearing formations of Colombia. Asphalt deposits also occur on the Mosquito Gulf, about 100 miles southwest of Colon, and also in the Gulf of Montijo, on the opposite or Pacific side of the Isthmus. Superficial examinations have been made at these localities, but no detailed surveys or development work have been attempted. From the evidence in hand it seems probable that commercial deposits of oil exist in this Republic.

### WEST INDIA ISLANDS.

*General statement.*—In the West India Islands, which lie to the north and east of the Caribbean Sea, between North and South America, oil indications have been found in Cuba, Haiti, Santo Domingo, Porto Rico, Barbados, and Trinidad. Drilling for oil has been done in all these islands except Porto Rico, but important commercial results have been obtained only in Trinidad.[1]

*Cuba.*—Indications of petroleum exist in all of the Provinces of Cuba, but the most productive localities are confined to Pinar del Rio, Habana, Matanzas, and Santa Clara. The surface evidences consist of oil seepages in serpentine or at the contact of serpentine and limestone. The limestone is of Cretaceous age; the serpentine is probably pre-Cretaceous. The deposits occur in crevices or joint cracks. Such of the oil as has been recovered is of a remarkably high grade, ranging from 55° to 70° Baumé (0.7568 to 0.7000 specific gravity). Only one well is at present producing in the island. This well, which belongs to the Cuban-American Sugar Co., is at Motembo, in the Province of Santa Clara, is about 1,900 feet deep, and yields 10 gallons of 70° Baumé oil daily. Other wells from 300 to 700 feet deep have been drilled in the same region. The most that has so far been taken from a single well (Cardenas) does not exceed 100,000 gallons. Another well is said to have produced 18½ gallons daily.

Drilling is now being done at Esperanza, in the Province of Pinar del Rio, where a well has reached a depth of 830 feet in limestone, with no results. At

[1] Owing to the writer's professional connections in Trinidad, he deems it inexpedient to discuss the oil resources or possibilities of that island.

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Minas, 15 miles west of Habana, a well put down near some seepages reached a depth of 350 feet, but encountered no oil. At Puentes Grandes a well sunk to a depth of 600 to 700 feet in 1913 encountered considerable quantities of gas. Another well is now being sunk at the same locality. Several wells have been sunk both east and west of Cardenas, attaining depths of 1,000 to 2,385 feet, the latter the maximum depth for the island. They have all started in limestone and finished in serpentine. Commercial production was not obtained in any of the wells.

To judge from personal observations made by C. B. Osborne, the writer's assistant, and other geologists, from the results obtained in the tests already made, and from the theoretically unfavorable conditions for extensive accumulations that surround the oil deposits in Cuba, it seems improbable that any considerable yields of oil will ever be obtained in the island.

*Haiti and Santo Domingo.*—Two localities in the island of Haiti yield indications of petroleum—one 8 miles north of Agua and the other on the coast near San Cristobal, 10 to 15 miles west of the town of Santo Domingo. The rocks from which the oil comes are said to be of Cretaceous age. The record of but one well, that at Agua, 7 miles northwest of Ocoa Bay, is available. This well attained a depth of 940 feet and is said to have flowed commercial quantities of an oil of about 20° Baumé gravity (0.917 specific gravity), carrying 2.5 per cent of sulphur. No remunerative results have as yet been obtained on the island, and whether this is due to unfavorable natural or commercial conditions is unknown to the writer. At best this island can be said to offer only insignificant potentialities so far as oil is concerned.

*Porto Rico.*—According to Redwood, exudations of petroleum are reported as occurring at several points on the island of Porto Rico, being possibly derived from the carbonaceous Tertiary beds. As no indications worthy of a serious test have yet been discovered, it seems unlikely that the island will ever yield oil in commercial quantities.

*Barbados.*—The deposits of petroleum and manjak (a type of asphalt) in Barbados are confined to the Scotland district, on the east side of the island. The containing beds are much-disturbed sandstones and shales of the Oligocene age, which are known locally as the Scotland beds and are probably related to the oil-bearing Tertiary formations of Trinidad. Shallow wells, some dug and others drilled, have been put down at three or four localities, yielding small quantities (1 or 2 barrels) daily of a moderately heavy black to greenish oil ranging from about 14° to 30½° Baumé (0.971 to 0.872 specific gravity). As the most favorable localities have been tested with only mediocre results, it can be assumed that Barbados will never become an important factor in the production of petroleum.

## SOUTH AMERICA.

*General conditions.*—Indications of petroleum were noted in South America as far back as 1788, when Humboldt described the oil seepages and mud volcanoes of northern Colombia, but little was done toward oil development until 1896, when active operations began in Peru. Even at the present time commercial production is confined to Peru and Argentina, and the combined yield of the two countries in 1914 was only about 2½ million barrels, or 0.6 per cent of the world's production. Practically all the countries of South America afford oil indications of more or less importance, but the principal attention is now being given to Colombia, Venezuela,[1] Peru, and Argentina.

[1] Owing to the writer's professional connections in Venezuela he deems it inexpedient to discuss the oil resources or possibilities of that country at the present time.

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*Colombia.*—General features: Although development of oil resources has been carried on in Colombia for many years no marked commercially successful results have yet been obtained. The oil ranges from the heavy oil of asphaltic type to a paraffin base oil of 41° Baumé (0.8187 specific gravity) and is believed to be derived largely from Cretaceous and lower Tertiary formations. The prospective territory may be divided into four general districts as follows:

TABLE 8.—*Areas included in the prospective oil districts of Colombia, in square miles.*

| District. | Area. | Possible oil territory. | Proved oil territory. |
|---|---|---|---|
| Caribbean | 15,000 | 300 | 1 |
| Pacific | 1,800 | 18 | ..... |
| Magdalena-Santander | 10,000 | 200 | 1 |
| Tolima | 7,500 | 100 | ..... |
| | 34,300 | 618 | 2 |

Caribbean district: The Caribbean district extends from Rio Hacha, on the west edge of the Guajiro Peninsula, southwestward along the Caribbean coast to the Gulf of Darien and Gulf of Uraba, and inland to include the Tubara and Turbaco fields and the region as far south as 30 miles south of Chima, on Sinu River, and Monpes, on San Jorge River, and up the Arato River valley for 90 miles from Punta Arena. It occupies portions of the departments of Magdalena, Bolivar, and Cauca. It is approximately 300 miles long and 50 miles wide, and contains 15,000 square miles. Of this area probably 300 square miles contains oil possibilities, while less than 1 square mile is as yet questionably proved as commercially productive. The rocks carrying the oil are mostly coal-bearing also, and are of early Tertiary, probably Oligocene age. The great bulk of the sediments are dark-colored shales, with sandstone members; the oil occurs in the sandstone, and also, to judge by the type of certain seepages, in joints in the shale. The structure is that of broad to sharply folded and faulted anticlines, and the surface evidences of oil are usually though not invariably confined to the anticlinal areas. The gravity of the oil ranges from 16 to 41° Baumé (0.9587 to 0.8187 specific gravity), the bulk of it, as now known, falling between 20 and 30° Baumé (0.9333 to 0.8750 specific gravity). In the only fields in which wells have been drilled the production of the individual wells has usually been under 10 barrels daily. However, these wells, of which only 10 are known to the writer, should not be taken as criteria for judging the possibilities of the country, as pioneer wells are usually shallow, are often not advantageously located structurally, and are always drilled under adverse mechanical conditions. It is the belief of those who have seen the various fields in this district that at least some of them give promise of yielding commercial quantities of oil of medium to high grade. The following are among the more promising localities in the district:

The Turbaco field lies 12 to 15 miles south of Cartagena, and its surface evidence of oil consists largely of mud volcanoes. Here Diego Martinez & Co. and their associates, the Standard Oil Co., have drilled five wells, ranging in depth from 500 to 2,200 feet, some of which are said to yield a medium-grade oil. This same group owns a small refinery in Cartagena in which oil imported from America is refined. The Standard Oil Co. is also drilling in the Sinu River Valley near Lorica.

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The Tubara field is 20 miles east of Cartagena. A Canadian company is operating here and has drilled three wells, ranging in depth from 700 to 3,018 feet, at least one of which yielded 7 or 8 barrels daily of oil having an asphalt base and a gravity of 22 to 26° Baumé (0.9211 to 0.8974 specific gravity). As many as 100 mud volcanoes are said to occur in an area of three acres in the vicinity of the wells. Sulphur springs and oil seepages occur at Usiacari, 2 miles south of Tubara, and oil seepages also are found 8 miles west of Tubara.

A seepage yielding 7 barrels daily of oil having a paraffin base and a gravity of 41° Baumé (0.8187 specific gravity) is reported by Mr. Vassar as occurring 10 miles south of Punta Arena, or 4 miles east from the Gulf of Uraba. This high-grade crude oil is used in lamps by the natives.

An area of 800 square miles along the west side of the Gulf of Darien yields coal and indications of oil having a gravity of 16° Baumé (0.9589 specific gravity). Indications of oil are also found at Rio Hacha, on the north coast, near Calamar, on Magdalena River, and near Baranca, back of Salgar, on the Puerto Colombia Railway, in the region of Calera Zamba and Savana Larga.

Pacific district: The Pacific district includes a belt 60 or 70 miles long, extending up the Pacific coast north of Buenaventura to Baudo River, and reaching inland to Atrato River at Quibdo and as far south as Cali, on Cauca River. The district is included in the Department of Cauca and occupies an area of 1,800 square miles, of which a very small area only—perhaps 1 per cent, or 18 square miles—has possibilities of oil. The oil on Baudo River is of 31° to 37° Baumé gravity (0.8696 to 0.8383 specific gravity), is associated with the "coal series," and probably occurs in a southwestward extension of the Caribbean coastal belt. Oil has also been seen floating on Andagueda River, a tributary of the Atrato. Heavy oil is reported east of Quibdo, where the Quibdo-Nedellin trail crosses Tutendnendo River; and also 20 miles from Santa Rosa and 4 miles north of Porce River, which is south of Nechi River.

Magdalena-Santander district: A district that is probably as important but more inaccessible and less well known than that along the Caribbean coast includes the southern part of the Department of Magdalena, the Department of Santander, and the western edge of the Department of Boyaca, extending from Magdalena River to the eastern Cordilleras. It also occupies an area in the southeastern part of the Department of Bolivar. It covers a belt approximately 200 miles long and 50 miles wide, or 10,000 square miles, of which possibly 200 square miles contain oil possibilities. The only proved territory is less than a square mile in extent and is found at Pamplona, near the Venezuelan frontier, where a small refinery handles the high-grade product of a few wells for the local trade. The oil in this district occurs in the Cretaceous limestones and sandstones, and the coal-bearing lower Tertiary (probably Oligocene) beds, where sandstones are the reservoirs. Long, well-defined, and in places overturned anticlines and possibly fault zones in the Cretaceous rocks are the advantageous structures for accumulation. The oil is of both high and low grade. The yield of the producing wells, which are all very shallow, is small, but greater yields will probably be encountered at greater depths. This district gives promise of some good fields of both high and low grade oil. The country is largely inaccessible at present, and its development will require immense capital and a long time.

Among the localities that have received special mention for their oil indications are Pamplona near the Venezuelan boundary; a belt between Cesar River and the Venezuelan frontier, touching the Magdalena above El Banco; an area near La Gloria on the Magdalena, where heavy oil and asphalt are

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found; and the seepages of Simiti in the Department of Bolivar. A line of seepages, some of which are reported to yield a barrel of oil a day, extend along the Magdalena flank of the eastern Cordilleras from a point south of Girardot northward to Bucaramanga. The beds along this line are sharply folded and in many places fractured.

Tolima district: Under the Tolima district may be grouped the occurrences in the upper Magdalena Basin, in the Departments of Cundinamarca and Tolima, and on the edge of the San Martin and Casanare plains. The oil-bearing rocks are probably of Cretaceous or Tertiary age and form a continuation of those in the Santander belt, to the north. In the Province of Medina, at the foot of the extinct volcano of Guaycarame, in that part of the Cordilleras which terminates in the plain of Medina, 7½ miles from Upia River, tributary to the Meta, petroleum of about 22° Baumé gravity (0.926 specific gravity) comes from shale fissures. At a point 140 miles south of Nevea, on the east side of the Andes, Mr. Vassar collected samples of paraffin-base oil testing 31 to 38° Baumé (0.8696 to 0.8333 specific gravity). He believes that this deposit may extend into Brazil. Oil is also reported from Santa Rosa, on the right bank of Magdalena River.

These deposits are all far from transportation facilities, and their development will entail great expense; furthermore, the markets will be entirely local until adequate communication is opened to the outside world. It is therefore obvious that these remote regions probably will remain undeveloped for a very long time.

Conclusion: The surface evidence and what drilling has been done leads to the conclusion that valuable deposits of petroleum of various grades exist in the Caribbean and Santander districts of Colombia. The testing and development of certain parts of the Caribbean district can be accomplished rather easily, but through the major portion of Santander and the other districts many natural obstacles will have to be overcome before commercial production can be attained.

*Dutch Guiana.*—Oil seepages or indications have been known in Dutch Guiana since the eighteenth century. There are three localities about which information is available at present. One is on the south side of Surinam River, 6 miles below Kabele station and 97 miles by rail south of Paramaribo. Here there are exposures of shale and some sandstone yielding small quantities of a high-grade amber-colored oil. A concession has been issued covering 1,700 acres in the region of the seepage.

Another area is situated on Marowijne River 100 miles above Albina. A shale formation cut by serpentine dikes occupies this region. The oil seepages, which occur along a stream course, are small, and are found in the shale about 5 miles from the nearest serpentine. The quality of the exuded oil is excellent.

A third belt lies between Surinam River and the railroad, about 48 miles above the head of deep-water navigation (16 feet). The oil here has a gravity of 45° Baumé (0.800 specific gravity) and occurs in small seepages.

To judge by the small size of the seepages and the little that is known of the geology of the country, it will be surprising if the oil deposits of Dutch Guiana are ever found to be more than unimportant local pools.

*French Guiana.*—Oil seepages occur in French Guiana southeast of Marowijne River, in formations which are the continuations of those that yield the seepages in Dutch Guiana. It is believed that the possibilities here are insignificant.

*Ecuador.*—The best-known oil field of Ecuador is that of Santa Elena, about 64 miles west of Guayaquil. The principal surface indications, consisting of "gum" deposits and oil seepages, occur at San Raimondo, where shallow-dug wells have been put down near the coast; and at Santa Paula and Achagian,



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2 or 3 miles inland. The field is believed to be a northward continuation of the Peruvian petroliferous area, and the oil comes from sandstones and shales of Eocene age. Forty dug wells at Santa Paula yield small quantities of heavy oil, which is taken to the coast on donkeys. A number of dug wells were formerly operated at Achagian. The oil ranges in gravity between 12 and 22° Baumé (0.985 to 0.928 specific gravity). Oil springs are reported on the east side of the Andes, 130 miles north of east of Guayaquil, and at points in the coastal plain north of the same port, particularly at Atacamas.

As the known deposits of Ecuador have not been thoroughly tested, any predictions as to their ultimate possibilities would obviously not be justified. However, as the surface evidences are rather meager it does not seem likely that this country will ever play a very prominent part in the oil industry of South America.

*Peru.*[1]—General conditions: Peru was the first country in South America in which oil was produced on a commercial scale. The yield in that country for 1914 was 1,917,802 barrels; the total production from 1896, when records of commercial quantities were first obtained, to 1914 was 14,306,972 barrels.

The petroliferous areas of Peru can be separated into two general provinces—that of the Andes, comprising at present the Titicaca field, and that of the coastal belt, in which are the more productive Zorritos, Lobitos, and Negritos fields. The coastal belt extends southward along the Pacific Ocean from the Ecuador frontier for 180 miles, to and beyond Payta, and is bounded on the east by spurs of the Andes. It is about 30 miles wide and occupies the Province of Tumbes and the northern part of the Province of Piura. Oil is found at several other points in the Andes, as in the Huallanca region, in Cerro de Pasco, and in the Provinces of Jauja and Parinacochas, but little or no development work has been done in these isolated regions. The total area included in the oil belts is over 5,000 square miles, of which about 100 square miles has oil possibilities, and 200 square miles, according to Mr. Hunter, can be said to be proved. The oil-bearing rocks are largely sandstones that are sufficiently porous to render shooting unnecessary. The formation is of Eocene age and its fossils closely resemble those of the California Eocene.

While the structure of the oil fields is very broken, the formation is essentially monoclinal, with the beds dipping to the eastward. Anticlines have been located in some places, but generally speaking the production is not obtained from them so much as from monoclinal structure with local saturation increased due to both dip and strike faults.

No very big gushers have as yet been encountered, but wells yielding up to 800 barrels a day have been struck. The initial production is not very long lived, and after a few weeks or months it settles down to from 4 to 7 barrels a day, which appears to be maintained for several years.

The specific gravity of the oil is from 32° to 43° Baumé (0.8642 to 0.8092 specific gravity), its average contents being gasoline, 15 per cent; kerosene, 35 per cent; residuum, 50 per cent. The residuum is capable of treatment into high-grade lubricants. The oil has an asphaltic base, though its asphalt content is remarkably small, being in certain places only about 1.5 per cent.

The depth of the wells ranges from 700 to 3,000 feet, the average being probably about 1,500 feet. The standard cable rig, with calf-wheel attachment, has been generally adopted and found to give very satisfactory results. The rotary has been tried, but owing to the amount of sandstone that is encountered it has not been proved very satisfactory.

Most of the production is exported, 80 per cent going to the United States, the remainder being sent to Chile, where it is consumed principally on the nitrate fields as liquid fuel.

[1] The data regarding Peru are largely furnished by Mr. Campbell M. Hunter, and the quotations are taken from a recent letter from him to the writer.

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The following figures of production of crude petroleum in Peru were compiled by Anne B. Coons, of the United States Geological Survey:

TABLE 9.—*Production of crude petroleum in Peru, 1896 to 1914.*

| | | | |
|---|---|---|---|
| 1896 | 47,536 | 1907 | 756,226 |
| 1897 | 70,831 | 1908 | 1,011,180 |
| 1898 | 70,905 | 1909 | 1,316,118 |
| 1899 | 89,166 | 1910 | 1,330,105 |
| 1900 | 274,800 | 1911 | 1,368,274 |
| 1901 | 274,800 | 1912 | 1,751,143 |
| 1902 | 286,725 | 1913 | 1,857,355 |
| 1903 | 278,092 | 1914 | 1,917,802 |
| 1904 | 345,834 | | |
| 1905 | 447,880 | | 14,031,066 |
| 1906 | 536,294 | | |

Zorritos field: The Zorritos is the northernmost of the Peruvian fields and lies a few miles south of Tumbes. The producing territory extends along the coast for about 4 miles, most of the producing wells being drilled at the water's edge. The Zorritos field is controlled by Señor Piaggio and produces from 70,000 to 140,000 barrels a year. The oil is of asphalt base and ranges from about 37° to 43° Baumé (0.840 to 0.810 specific gravity). The wells are from 650 to 850 feet deep and yield an average of 6 barrels a day. Initial yields of several hundred barrels are reported.

Lobitos field: The Lobitos field lies south of the Zorritos field, about 60 miles north of Payta, and comprises a proved area of 25 square miles. In character of the oil and productivity of the wells this field is similar to Zorritos. It is controlled by the Lobitos Oil Co. and yields about 560,000 barrels annually.

Negritos field: The southernmost of the developed coastal areas is the Negritos field, which lies 40 miles north of Payta and includes about 150 square miles of proved territory comprised in the hacienda La Mina Brea and Parinas. The oil is brown and ranges in gravity from 35° to 38° Baumé (0.848 to 0.834 specific gravity). The wells range in depth from 500 to 3,000 feet, and in individual production from over 800 barrels daily to an average settled production of 4 to 7 barrels. The Negritos field is controlled by the London & Pacific Petroleum Co. (Ltd.) and yields about 1,260,000 barrels annually.

Titacaca field: The Titicaca field lies high in the Andes, 8 miles from Titicaca Lake, near the Bolivian frontier. It is controlled by the Titicaca Petroleum Co. and in 1910 yielded 50,000 barrels of oil. An anticline is said to extend through the field in a N. 40° W. direction and the formations on its flanks are much disturbed. Ten wells have been drilled up to 1908, with varying results. Although the initial production in some wells has been as high as 900 barrels daily, the output falls rapidly. The oil is unlike that of the northern fields of Peru, as it contains about 5 per cent of paraffin wax and 40 to 50 per cent of kerosene.

Conclusion: The evidence in hand indicates good possibilities for the Negritos field and probably a less important future for Zorritos and Lobitos. The Andean petroliferous areas are little known, but no very promising fields are believed to exist in this province.

*Bolivia.*—The oil fields of Bolivia are believed to form in general a continuation of those found along the eastern base of the Andes in northwestern Argentina. The fields extend from the vicinity of Santa Cruz, on the north, through Sauces to Piquirenda, Plata, and Guarazuti, in the province of Tarija,

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near the Argentine boundary. Springs and seepages of petroleum are found at several points throughout this general region, coming chiefly from Lower Cretaceous dolomites. Some exploratory work and shallow test drilling has been done in the region, resulting in the finding of some high-grade oil, 35 to 47° Baumé (0.850 to 0.790 specific gravity). Mr. Hunter, under whose direction the test drilling was done, says: "The formation is very broken, being sharply folded and much faulted. Owing to the inaccessibility of the oil fields there is likelihood of serious development work being initiated until better transport facilities exist." Still more recently geologic investigations in the area between the Incahuasi and Aguaraygua ranges, south of Sucre, have shown the presence of a considerable area of prospective oil land. It is the writers' belief that these fields, owing to their comparative inaccessibility, will not be an important factor outside of the local Bolivian market, at least for a very long time.

*Chile.*—Chile offers little inducement to the oil prospector, on account of its general unfavorable geologic conditions and paucity of surface evidences of hydrocarbons. Indications of petroleum are found south of Patillos, in the Province of Tarapaca, northern Chile, and oil has been reported as occuring at Puerto Porvenir and Agua Fresca in Magallanes Territory. There is also an extensive area south of Maullin River which gives indications of gas in Tertiary beds. These facts, derived from Redwood, lead to the conclusion that Chile is destined to play little or no part in the oil industry of South America.

*Argentina.*—General conditions: Argentina first attracted attention as a possible producer of petroleum in 1907, when oil was discovered, entirely by accident, in drilling for water at Comodoro Rivadavia, on the coast of Patagonia. Previous to that time test drilling had been done in the Andean portion of the Republic, but no significant results were obtained. The area included in the petroliferous districts exceeds 8,000 square miles, and of this territory probably 400 square miles gives superficial evidence of petroleum. The proved area does not exceed 2 square miles. The petroleum occurs in rocks of Jurassic, Cretaceous, and Eocene Age, limestones, dolomites and sandstones predominating. Both anticlines and practically structureless areas yield commercial quantities. The oil is asphaltic and ranges in gravity from 11 to 24° Baumé (0.996 to 0.9091 specific gravity). The wells attain depths from 200 to more than 4,000 feet and are rather small producers, so far averaging less than 100 barrels daily. The production, which was approximately 275,000 barrels in 1914, comes entirely from the Comodoro Rivadavia district and is consumed in the country, principally for fuel.

The petroliferous area of Argentina is divisible into three principal districts—the Comodoro Rivadavia district on the Atlantic coast, and the Salta-Jujuy and Mendoza-Neuquen districts in the Andean region.

The Comodoro Rivadavia district, the best known and only commercially productive field in Argentina, is situated on the Gulf of St. George, 850 miles south-southwest of Buenos Aires. According to the Government geologists who have studied the district, the possible petroliferous area is extensive, possibly including 20 square miles; some other geologists are still more optimistic, and a few think that the productive area will be confined pretty closely to the present proved area of 1 or 2 square miles. The oil-yielding formation is of Cretaceous age, the oil coming from coarse pebbly sandstone, which lies on schist and granite and is unconformably overlain by Eocene and later Tertiary tuffaceous and fossiliferous beds. The origin of the oil is obscure. The beds dip at a low angle, not exceeding 12 feet to the mile, and said to occupy a broad syncline or shallow downward warp. The oil is of asphaltic base and ranges in gravity from 21½ to 24° Baumé (0.925 to 0.9091 specific gravity). The

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average daily production of the wells is between 50 and 100 barrels, although some of the wells have had an initial yield of over 1,000 barrels daily. There are now about 20 wells in the district, of which about 10 can be rated as successful producers. They range in depth from 1,500 to 1,800 feet, being fairly uniform in this respect. The oil is used for fuel on the national railways.

The following figures relating to the Comodoro Rivadavia field are copied from La Nacion, of Buenos Aires, issue of April 8, 1915, with equivalents in American barrels:

TABLE 10.—*Production of crude petroleum in the Comodoro Rivadavia field, Argentina.*

| Year. | Liters. | American barrels of 42 gallons. | Year. | Liters. | American barrels of 42 gallons. |
|---|---|---|---|---|---|
| 1907 | 16,009 | 101 | 1911 | 2,082,460 | 13,119 |
| 1908 | 1,820,937 | 11,472 | 1912 | 7,461,495 | 47,007 |
| 1909 | 2,999,188 | 18,831 | 1913 | 20,732,808 | 130,618 |
| 1910 | 3,294,124 | 20,753 | 1914 | 43,780,014 | 275,500 |

There is a great divergence of opinion as to the possibilities of this district owing, no doubt, to the fact that the mode of occurrence of the oil is unique, so that further development will be followed with interest. It seems probable that the production of individual wells will never be great, and therefore the field can not become a large producer unless the producing land is found to have a wide extent.

The Salta-Jujuy district occupies a roughly triangular area with sides approximating 100 miles in length in the Andean region of northwestern Argentina, adjoining the Bolivian frontier between 800 and 900 miles northwest of Buenos Aires. Its fields are practically continuous with those of Bolivia. The district includes approximately 5,000 square miles, of which about 250 square miles contain evidences of petroleum; less than a square mile has actually been tested, and the results have been indifferent. The oil reservoirs are sandstones and dolomites of Jurassic and possibly Cretaceous age; the accumulations of oil are in long, fairly well defined anticlines. The anticline dominating the Sierra Aguaraygua extends into Bolivia. The oil is black and asphaltic and ranges in gravity from about 11 to 14° Baumé (0.996 to 0.975 specific gravity). The production of the wells so far drilled has been very small.

In the Tartagal region the anticlines extend north and south. Two wells, both of which were poorly located with regard to the structure, reached depths of 150 and 450 feet without results. At Quebrada Galarce four wells showing some oil and gas have been drilled to depths ranging between 127 and 574 feet. Seepages are also known at Yavi Chico, Tejada, Abre de la Cruz, Garrapatal, Laguna de la Brea, and Cerro de Calileegua.

The presence of well-defined anticlines and good oil seepages indicates the probable presence of commercial deposits of oil, the tests already made were only partial and tell little or nothing of the possibilities of the district.

Mendoza-Neuquen district: Evidences of petroleum have been found in a series of shales for nearly 300 miles along the eastern Andean slope, beginning 40 miles north of Mendoza and extending southward to latitude 42° in the Neuquen region. The district is from 600 to 800 miles southwest of Buenos Aires, and only its north end is accessible by rail. At least 6,000 square miles are included in the district; the area showing oil possibilities probably

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does not exceed 300 square miles, and the proved area is less than 1 square mile. The beds yielding the oil in the north end of the district are said by Dr. Windhausen to be of upper Jurassic age; those in the south end, according to Dr. Bailey Willis, are of Eocene age. The oil comes principally from sandstones and marls and has a gravity of about 20° Baumé (0.935 specific gravity). The wells yield only a small production and are short-lived. East of the main Andean belt the lower Jurassic limestones and Cretaceous beds are also said to be petroliferous, especially along the upper part of Salado River in latitude 35°, longitude 70°.

The principal developments are at Cachenta, near Mendoza, where 12 wells had been sunk up to 1893, the total yield of the wells up to that year being 10,000 barrels. A pipe line was built to Mendoza, but owing to the exhaustion of the wells the venture was not a success. Two wells were also drilled by the Neuquen Oil Syndicate at Cerro Tolena between 1908 and 1910. These are said to have yielded a little oil. Four or more test holes put down at Covunco, 105 miles west of Neuquen, attained depths between 262 and 1,180 feet and encountered some gas and oil. In 1913 a well was put down at San Cristobal, in the Province of Santa Fe, and attained a depth of more than 4,000 feet. It is reported that some oil was found in this well.

Seepages and other evidences of petroleum, including rafaelite, a kind of asphalt, have been reported from San Rafael (south of Mendoza), Cerro Auca Mahuida, Rio Barrancas, Curileuva, Garrapatal, La Brea, Vachenta, La Carena, and Plaza Huincul, or Challaco, "north of kilometer 81, on the railroad."

The developments in the Mendoza-Neuquen district, like those in the area farther north, lead to pessimistic conclusions regarding its future, but, like pioneer work in most other oil fields, this development has probably been carried through under more or less adverse conditions, and it is to be assumed that the results do not stand as a final test of the whole region.

Conclusions: With the exception of the region about Comodoro Rivadavia field the country between the Atlantic Ocean and the front of the Andes offers little chance for the accumulation of oil in commercial quantities. Furthermore, it is questionable whether or not the productive area of Comodoro Rivadavia will be extended; if it can be, the field is certainly ideally located for developing and marketing its product. There are favorable indications for the development of commercial production in the Andean districts, probably the most encouraging areas being in the northern fields. In general the sharp and in places overturned folds of the mountain districts do not suggest extensive deposits or possibilities for large wells, but small wells yielding oil of various grades are to be expected when test drilling is systematically and thoroughly attempted. In general it is doubtful whether any great fields of oil exist in this country, although detailed investigations may change this conclusion.

*Brazil.*—The present known oil resources of Brazil are apparently confined to the oil shales of the Bahia region and a rather indeterminate area of favorable oil indications somewhere in the interior. The oil shales are of Eocene age and extend intermittently from Porto Alegre along the coast for over 1,200 miles, nearly to the mouth of the Amazon. Portions of the shales suitable for distillation have been reported at the following, among other localities: North of Ilheos, on Itahipe River; on the Island of Joao Thania, in Marahu River, 80 miles south of Bahia; on Tinhare Island, 30 miles south of Bahia; at Riachedoche and Camarajibe, 25 and 45 miles, respectively, north of Macelo; in the province of Alegoas; and in the Sierra de Araripe, in Ceara. It seems probable that the formations that are oil-bearing in southeastern Colombia, especially south of Nevea, may extend over the boundary into Brazil. Even if such is the case the deposits will be inaccessible for some time to come. Dr. J. C.

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Branner, the authority on Brazilian geology, believes that the chances for recovery of commercial quantities of petroleum are rather problematic except in the regions mentioned, which means that the enormous extent of territory in Brazil will probably remain a negligible factor in the oil industry of South America, at least during the present generation.

SUMMARY TABLE OF THE OIL RESOURCES OF THE AMERICAS.

The following table is intended to summarize the present knowledge of the oil resources of the Americas by countries. Attention is called to the fact that of an estimated total of 8,429 square miles of oil land on both continents, 4,365 square miles, or over one-half, has already been proved. The estimated future supply of the United States is 5,763,100,000 barrels; outside of this country the data is so meager that even rough quantitative estimates are out of the question.

TABLE 11.—*Summary of oil resources of the Americas.*

| Country. | Proved area. | Prospective area. | Production to 1914. | Present yearly rate of production. |
|---|---|---|---|---|
| | *Sq. miles.* | *Sq. miles.* | *Barrels.* | *Barrels.* |
| Newfoundland | | | Small. | (?) |
| Canada | 25 | 1,000± | 23,498,610 | 214,805 |
| United States | 4,109 | 946 | 3,335,457,130 | 265,762,535 |
| Mexico | 25 | 1,000± | 90,359,869 | 21,188,427 |
| Guatemala | 1± | (?) | (?) | (?) |
| Panama | | (?) | | |
| Trinidad | (1) | (1) | 2,069,430 | 543,533 |
| Colombia | 2± | 618 | | |
| Ecuador | 1± | (?) | (?) | (?) |
| Venezuela | (1) | (1) | (1) | (1) |
| Peru | 200 | 100 | 14,306,972 | 1,917,802 |
| Bolivia | | (?) | | |
| Argentina | 2 | 400 | 600,000 | 275,500 |
| | 4,365 | 4,064 | 3,366,287,021 | 290,002,592 |

[1] Owing to the writer's professional connections in Trinidad and Venezuela he deems it inexpedient to discuss the oil resources or possibilities of these countries at the present time.

METHODS OF CONSERVATION.

The principal facts concerning the oil deposits of North and South America as we now know them having been presented, the next question to be considered is how best to utilize the present output and how most economically to discover and develop the gas and petroleum resources which are yet hidden in the earth. The following suggestions are offered in the hope that they may guide those who are interested in the future development of these resources away from some of the troubles that have beset the oil industry in the past. As others are to discuss some of these methods of conservation in detail, the writer will confine himself to some of the broader generalities.

*Titles.*—Conservation in developing the oil resources of any region should begin with an investigation of the validity of the title to the land containing the oil, for drilling oil wells on land with unsound titles might be likened to building a house on the sand. If the property is situated in a region of fee or freehold titles ("patented lands," as it is often called in the United States), the quality of the title can be determined by procuring an abstract. Care should be taken to see that the mineral rights are included in the title to the land in regions where mineral and surface rights may or may not go together. In most countries outside of the United States the mineral rights are alienated

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from the surface rights, so that separate titles must be obtained for the minerals. Such titles should always include the right to utilize the surface so far as is necessary for all purposes of development by paying reasonable damages to the owner of the surface rights, and if possible, a fixed amount of damages should be agreed on before development starts, as the term "reasonable" is capable of many interpretations.

If the oil is to be developed under concessions or leases the operator should be absolutely certain that the contract comes from parties authorized to grant it. Furthermore, assurances should be had that the wording of the concession or lease will be interpreted along broad lines; quibbling or taking advantage of technicalities usually results disastrously for both parties. The terms of the contract should be as explicit as possible, and the more liberal the conditions the easier will it be for those who intend to carry on the projected development to operate. The conditions of a concession or lease should be framed to facilitate rather than retard the development. As a general statement, it is not fair to ask intending operators to pay for the privilege of risking their money in proving up prospective land, and therefore it is much more equitable for the owners of the mineral rights to obtain their remuneration through royalties than through bonuses or excessive rentals. A sliding scale of royalty is often more desirable than a fixed percentage. For self-protection the owners necessarily should place a rental clause in the concession or lease, to guarantee development within a reasonable time. An observance of the spirit as well as the letter of such contracts on the part of both the grantor and the grantee usually works to the best advantage of all concerned and furthers the ends of conservation.

*Exploration.*—Much of the money that is expended uselessly in the oil industry is wasted in the drilling of dry holes. However, dry holes are as much a part of oil development as waste lumber is an accompaniment of house building. It is impossible for anyone to say definitely from surface evidence whether oil does or does not exist below the surface of the earth at any particular spot—the drill is the final arbiter of this question, and even the drill does not always tell the truth—but there is a way in which exploration may be conducted to bring about the most satisfactory results with the least expenditure of energy and money. The cost of exploratory work is charged against the capital account in any field, so that what is saved in the preliminary stages of development is a cut in the ultimate cost of the field's product.

It ought to be as obvious that exploration with the drill should be preceded by careful geologic studies as it is that railroad construction should be based on surveys. These studies should include such subjects as topography, stratigraphy, structure, and surface evidence of petroleum in the regions to be tested. The work divides itself into two stages—preliminary reconnaissance and detailed surveys.

The preliminary reconnaissance should consist in procuring all the available published and hearsay evidence regarding the occurrence of oil or gas seepages or hydrocarbon deposits in the region; in making preliminary geologic surveys to determine from which formations the oil is to come and the areal distribution of these formations; in determining those general regions in which the surface evidence is supposed to be most favorable for the accumulation of hydrocarbons; and in determining the best routes and methods of transportation.

The second stage includes detailed geologic surveys of those regions where the surface evidence indicates that petroleum is most likely to be found and the location of test holes at favorable points. By working out the surface distribution and structure of the formations it is usually possible to select the

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areas offering the best chances of success. Geology should always be the dominant factor in determining the location of test holes, although modifications to meet natural conditions must sometimes be made. Nothing is so encouraging as a successful first hole; nothing so disheartening as the failure of an initial test; so every other consideration should be sacrificed to make the first effort at the place where success is most likely. Just what character or degree of evidence should determine whether or not drilling is advisable must be decided separately for each area. So many factors enter into decisions of this kind that no set rules of action can be laid down. As a prerequisite to carrying on such work the investigator should have a general knowledge of the occurrence of oil in the other fields of the world, and, if possible, definite information concerning the interpretation of the surface evidence in the particular type of deposit under examination. As has been tersely stated by one of the most successful oil men in the world, "Wherever the Lord put a deposit of oil He left a little on top to show its presence in the ground below." It is hazardous enough to drill with favorable evidence in hand; it is many times more so to locate a well without reference to the surface evidence and geology of the region. Drilling blindly without a definite basis for action is working against conservation, and for every well so drilled that has been successful, a hundred can be cited that have resulted in failure.

*Development.*—After locating the best point for the sinking of a test well in any new field, the next questions which confront the operator are those of development. These include the choice of proper equipment, its transportation and installation, the building of camps, and preparation for the proper care of the oil in case the well is successful. Prior to the proving of an area by a successful test well, the less that is expended in the way of equipment, road building, etc., the better. It is therefore often more desirable to put up with crude methods of transportation, temporary camps, and improvised tools than to spend great sums in installing a plant that may have to be almost immediately abandoned. Ordinarily it is much better to drill a test hole with a standard churn drill than with a rotary, for the reason that the well record secured by the former is, as a rule, much more reliable than that yielded by the latter—and the log or record of the test well is its greatest asset. Furthermore proper gates or safety casing-head equipment should be installed when the oil zone is approached, for it is often possible to control the strong initial flows or "gushes" of a particular sand or zone by such means, where lax methods of drilling would cause a great loss. Even under the most favorable circumstances, however, and with the assistance of specially designed gates or casing heads, oil is liable to be lost when a well is brought in, particularly if the gas pressure is strong, for the action of fluids under great pressure is very sudden and is sometimes most disastrous to the apparatus installed for its control. After the drilling of test holes, which it is assumed will give a general idea of the location and character of occurrence of the oil deposits, it is comparatively easy to decide upon proper equipment for the drilling of future wells. In general, the standard or churn drill is the most satisfactory in a region of hard rocks, while for soft formations and for the control of strong gas pressures above the oil sands the rotary is often the most efficient. In the matter of camps it always pays to make the lives of the men in the field as attractive as possible. Oil men are of the highest type and most discriminating of artisans, and as long-continued service is the most efficient and economical, it is the best policy to make them contented by providing good food, proper shelter, and a reasonable amount of diversion.

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*Production.*—When the wells have been satisfactorily drilled and finished the matter of production presents itself. It is easy to handle the product of wells that flow from a moderate natural-gas pressure, but in general the great bulk of the wells of the world do not flow but have to be pumped, and some tap deposits under pressure so great as to render their operation difficult. Where the gas pressure is high great care must be exercised in finishing the wells and in their constant control, for a "wild well" is usually the most wasteful thing about an oil field. Furthermore, high pressure implies the presence of great quantities of valuable gas which should be utilized if possible. The installation of proper gas traps and the economical use of the gas for fuel, illuminants, or the manufacture of gasoline are therefore other problems facing the operator who wishes to conserve his resources. In pumping wells the method adopted and the skill with which it is conducted often determine whether or not the well is a paying one or is operated at a loss. In general, shallow wells can be operated by the ordinary lift pump, several wells being handled from a common "power." If the wells frequently "sand up" or give trouble from caving, it is usually economical to maintain a drilling engine at each well in order to remove the tubing and casing when necessary for the purpose of cleaning the hole. Under certain conditions, where water is present with the oil, the air-lift method of recovering the oil is satisfactory and economical. The utilization of waste gas for the development of power or the utilization of electricity generated by water power is often more economical than the burning of the oil. It has been estimated that 10 to 15 per cent of the oil produced in California is either used as fuel in the fields or is wasted in production and through careless methods of handling. The greater part of this waste could be saved by the use of hydro-generated electricity, which is as cheap as the oil if not cheaper, and the practice of greater care in the fields. The waste of oil that is questionably excusable in the strenuous early period of any field is seldom excusable and should be made criminal in the later stages of development.

*Transportation and storage.*—After the oil has reached the surface it is necessary to store it and transport it to market. The storage of oil in open reservoirs, especially those made of dirt, is most wasteful, but is often unavoidable in new fields and in places where flush production mounts higher than the steel storage facilities. If possible, however, oil should be kept in cement-lined, covered reservoirs or covered steel tanks. Tanks of the ordinary type, holding 37,500 and 55,000 barrels, have been found the most economical for general purposes. Cement-lined or reinforced-concrete reservoirs holding as much as 7,000,000 barrels are in successful use. The tanks should be set in large earthen reservoirs to prevent the loss of oil in case of accident, and should be widely enough separated to keep fire from spreading if the tanks are struck by lightning or fired from other causes. Painting the tanks white is also a method of conserving oil, as it keeps down the internal temperature of the tank in hot countries, thus lowering the precentage of loss through volatilization.

Pipe-line transportation is usually the most economical and satisfactory, although under certain conditions tank cars and barges are more satisfactory if the oil is exceedingly heavy or the quantity small. The latter type of transportation is often economical if waterways are adjacent to the oil fields and market terminals, as in the Panuco field of Mexico. A careful study of transportation questions, especially those relating to pumping, will often lead to a great saving over the method of hit-or-miss adoption of a transportation system without investigation. Each field and each type of oil has its own problems, and before putting in pipe lines it is always an economy to procure the latest information regarding the experiences of others in similar matters.

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*Utilization.*—After the oil has been produced and is ready for refining or for the market, the forms in which it is to be used should be a matter of the most careful investigation. Naturally, oil of the heavier grades is best suited for the manufacture of asphalt, for use as fuel, and for such other minor uses as road dressing and the manufacture of roofing materials. Oil of the lighter grades should always be refined, as the lighter constituents, which can be taken off even by a crude process of topping, often yield a greatly increased price over that of the crude oil. The utilization of the tops in the manufacture of staple and by-products usually results in the maximum profit that is made in the oil business. Probably the greatest waste of oil at the present time comes through its use in connection with the steam engine, for were this same oil used in the internal-combustion engine of the Diesel type the saving would be from 75 to 80 per cent. This saving will come about only with the perfecting of the internal-combustion engine and a marked rise in the price of oil, and then only under conditions where the engine of the Diesel type can be satisfactorily substituted for the steam engine.

In conclusion, it should be borne in mind that the best way to meet the demands of conservation is to hunt for and produce the oil with as little loss and as cheaply as possible, to utilize it for those purposes for which it has no substitute, and to avoid using it for those purposes, as for fuel to produce steam, for which such substitutes as coal or water power are available. This sentiment, so happily expressed by Dr. C. W. Hayes as "utilization with a maximum efficiency and a minimum of loss," should actuate all who have the best interests of the oil industry of the Americas at heart.

The CHAIRMAN. The Chair feels sure that he voices the sentiment of all present when he extends his sincere thanks to Mr. Wegemann for his presentation of this valuable paper. In the absence of the author it seems to me it is almost unnecessary to discuss this paper, unless there are actual errors in the statement, or omissions or additions to make. If anyone wishes to make any suggestion in that respect, that should be done now.

Mr. CLAPP. I do not remember that the New Brunswick district was mentioned.

The CHAIRMAN. It was mentioned, but not considered.

Mr. CLAPP. If I understood correctly, the statement was made that the world's supply of petroleum will come from the Americas. Did I understand that correctly? I think we ought to question that, because we know that there are extensive deposits of oil in other lands which are as yet practically untouched. Russia has tremendous deposits. Siberia has enormous fields. I have talked with people who claim to have seen those fields. China is supposed to have oil deposits. Turkey has very extensive and valuable oil areas, and there are oil areas in Hungary which have been little touched. It is a strange thing to me that in Europe, where things are supposed to be up to date, that there should be these untouched fields.

The CHAIRMAN. As the hour is growing late I must now call for the paper of Dr. Day on "The petroleum industry of Mexico."

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## THE PETROLEUM INDUSTRY OF MEXICO.

By DAVID T. DAY.

The compounds of carbon and hydrogen which make up petroleum form the starting points, or fundamental substances, upon which the entire structure of organic chemistry is built. When one considers that included in this domain of organic chemistry are all our food products, our paper, our fabrics, in fact all animal and vegetable substances necessary for life's economics, it gives a new respect for a material much of which is no longer used even for such advanced purposes as illumination, but is subordinated to the place of a mere fuel.

It is safe to state that much more than one-half of all the petroleum that Mexico has yet produced has been burned as fuel. It has been burned in the most wasteful manner, and, even worse, not on Mexican soil for the production of power for the development of manufacturing, but has performed lowly if useful service for other countries. Even as fuel, Mexican petroleum has been sufficiently appreciated to cause its exportation, chiefly to the United States, but also to the West Indies, South America, Great Britain, France, and Germany. It will be the object of this essay to predict a more hopeful future for Mexican petroleum and to point out avenues of usefulness which are rapidly being developed in this country in advance of other sections of the world, and in which Mexico's great wealth in petroleum must share. It is enough in introducing the subject to call attention to the fact that instead of extracting a meager fraction of gasoline from crude oil, merely what is found in the natural substance, then extracting a larger fraction for illuminating purposes, then such an amount of lubricating oils as may be at the time necessary for industrial purposes and consigning the entire balance to shameful waste as a fuel, the petroleum chemist, within the last two years, has found himself able to induce capital to invest on an increasingly great scale in the conversion of oil into other products. The fact is well known to pure science that this crude oil can be converted by heat and chemical means into any desired proportion of the products for which there is the greatest need. The chemist has taught the capitalist that there is no substance known to man so flexible, so readily changed from one form into another as this complicated material we call petroleum. What the chemist has long known from the theoretical point of view, the technologist is now about to employ. This indicates the fact that the various components of petroleum can be used as a starting point for all animal and vegetable materials in their essentially simple forms. It also points out avenues of research by which this present fuel oil can be built up, even into foods. With this more encouraging outlook let us examine, first, the present and potential value of Mexico as a great oil-producing country and see what the probabilities are for future production—all this briefly reserving the principal time for the discussion of what petroleum may yield that country in the future.

### HISTORY.

It can safely be said that no circumstance of importance concerning the history of the development of petroleum in Mexico has failed of record by recent writers. Nearly all these, however, have been authorities especially interested in some local feature of the Mexican petroleum fields, and each has relied more or less completely on fellow authorities for information concerning all of the regions beyond the one locality of special interest to him. To this situation there has been one decidedly important exception—Mr. Degolyer, chief of

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the Geological and Exploration Department of the Compania Mexicana de Petroleo Aguila, who has given the benefit of his broad experience in the development of the Mexican oil fields to a history of petroleum in Mexico. From this much of the information here presented has been derived, and to it the reader is referred for statements in greater detail than are here possible. What is given below will be most valuable if it represents a compilation from the best authorities rather than mere statements of what any one person could learn by such repeated visits to the oil fields of Mexico as any one foreign observer could make.

Villarello,[1] Degolyer,[2] and others point out that the earliest records of the occurrence of petroleum in Mexico refer to the large deposits of asphalt, usualy hard, sometimes semisolid, occurring from San Jose de las Rusias in the northern part of the state of Tamaulipas and frequently noticed southward, especially in Vera Cruz near Tumbadero. It was later found that these deposits of asphalt represented the residual material from the evaporation and oxidation of oil reaching the surface as thick, tarry material. Hundreds of such tar springs are now known and are carefully sought out as the best guide in the search for oil.

It is further interesting to note that in this stretch of country, bordering on the Gulf of Mexico, from San Jose de las Rusias southward to the Isthmus of Tehuantepec, actual drilling for oil was repeatedly undertaken back in the early history of this region, although the efforts were too feeble for the problem in hand and failed for lack of sufficient depth. Thus Friar Sagahun wrote in the seventeenth century of the occurrence of "chapopote"—the Indian name given indiscriminately to thick oil or asphalt seepages. Reliable reports affirm that as would be expected this thick tar was used as primitive people have always used it when available for embalming, religious ceremonies, and for healing compounds. The ruins of Yucatan show its use as a building material. Degolyer cites, as the first attempt to develop oil or gas, the records of Memoria de Fomento of 1865. Permission was then granted to Señor Ildefonose Lopez for developing the petroliferous substances near San Jose de las Rusias in the state of Tamaulipas. Other concessions were also granted not long after the beginning of the oil industry in the United States, and in 1868 a little oil was refined by a company of Mexico City and obtained from a well 125 feet deep drilled in the Furbero district some 50 miles south of Tuxpam.

Degolyer's history also shows that asphalt was mined near Tempoal, in the Canton of Tantoyuca, along the Tamesi River. Before 1883 several shallow wells were drilled purposely for oil in Mexico; two of them near the present great oil field of Potrero del Llano, west of Tuxpam. One of them is reported to have flowed.

Previous to 1883 oil in Mexico was the property of the government. In that year the present mining law was enacted by which the ownership of petroleum rights goes with the ownership of the surface of the land. Prior to the real beginning of the oil industry in Mexico in 1901 many attempts at oil-well drilling were made, including those of the Mexican Petroleum & Liquid Fuel Co. (Ltd.), in which Cecil Rhodes was interested, and which drilled 24 unsuccessful wells. Messrs. Doheny and Canfield, of Los Angeles, Cal., purchased land in the state of San Luis Potosi, guided by the expert advice of Dr. Ezequiel Ordoñez, the Mexican geologist. Their first successful well was drilled near Ebano, 50 miles west of Tampico, near the line of the railroad from Tampico to San Luis Potosi, to which spot prospectors were guided by oil

[1] Villarello "Algunas regiones petroliferas de Mexico," Bol. Inst. Geo. de Mex., No. 26, p. 34.

[2] E. Degolyer, Oil and Gas Journal, April 16, 1914.

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seepages. About this time many shallow wells were drilled, not only in Vera Cruz, Tamaulipas, Chiapas, and near Guadalupe, but as far south as Tabasco, and various asphalt companies actually made efforts to mine the surface deposits of asphalt near Tuxpam and Ozuluama.

The year 1894 was memorable in the oil development of Mexico, when the territory exploited by Percy Furber, known as Furbero, south from Tuxpam, brought in a well of considerable size. The Mexican Petroleum Co. (Doheny and Canfield) brought in "Pez No. 1," a very large well at Ebano. This well has flowed continuously up to the present time. The year 1907 was made eventful by the drilling in various parts of Vera Cruz, including the well of the Pennsylvania Oil Co. at San Diego de la Mar, near Tamiahua Lagoon, and at Tumbadero by the Pearson interests, while at Juan Casiano and Tres Hermanos, the Huasteca Petroleum Co. (Doheny and associates) began drilling, which developed one of the largest wells in the world. Operations of slight success were also carried on at Los Esteros and Tamache, in the State of Tamaulipas.

In the following year the developments of the Pearson interests in Tabasco, near Frontera, including the finding of paraffin oil of high grade similar to the Pennsylvania product, induced them to build a refinery at Minatitlan on the Isthmus of Tehauntepec.

In May the discovery well of the Dos Bocas field, San Diego No. 2, was drilled, yielding 2,500 barrels per day, but on July 4, San Diego No. 3 was brought in. This well barely penetrated the productive stratum; in fact, it was the great pressure of oil below which "drilled in" the well. The oil spouted high above the derrick, and the pressure was so great as to crack open the soft ground in the direction of the boiler plant. The gas ignited from the fire under the boilers within 20 minutes of the time the eruption began. With a flow of 10,000 barrels for the first day of this well, the eruption increased, the casing was torn from the well and a great flood of oil fed the fire, which could be seen from Tampico, more than 80 miles away. The force of the escaping gas, oil and hot salt water was sufficient to enlarge the mouth of the well from 16 inches to a large crater, which, by caving and the force of the expulsion of soft earth by this enormous geyser, soon extended to an area of more than 30 acres. In spite of the loan of troops from the engineer corps of the Mexican Army it was impossible to extinguish the fire until its greatest force was spent. Then Mr. Charles Ganahl, by jetting in gravel with a hydraulic giant, succeeded in sufficiently choking the flow to extinguish the fire. But in the 57 days of flow the oil was practically exhausted and was succeeded by hot salt water, which still flows with occasional small amounts of oil and asphalt. Subsequent drilling showed that the region has been drowned out by the water.

In 1911 fruitful wells were drilled at Chijol, near Ebano, and the Topila field, near the Panuco River, was developed nearest of all fields to the city of Tampico. In 1910 the explorations of Prof. Cummins, the geologist of the East Coast Oil Co., brought in No. 401, the discovery well in the Panuco fields, and wells were drilled at Tanguijo and San Pedro districts by the Mexican Eagle Petroleum Co. (Pearson interests). The Huasteca Petroleum Co. opened the great Juan Casiano field, drilling in No. 6 and No. 7; No. 6 with 14,000 barrels per day and No. 7 with 28,000 barrels per day. Meanwhile the geological work of the Mexican Aguila Co., reorganized by Dr. C. Willard Hayes, pointed to the Potrero del Llano district (where abortive efforts at oil drilling had already been carried on) as the most logical region for developing a great oil pool, a decision reached entirely on geological grounds. Potrero del Llano, No. 4, was located by Dr. Hayes, and he has personally related to the writer

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how on December 23 it was necessary for him to encourage the driller to continue at work when it was generally believed that the well would be a failure. The day before Christmas, 1910, Dr. Hayes left the well to visit other properties, urging that the well be continued another 20 feet. Before his horse had taken him more than two hours' ride from the well the driller had gone 12 feet lower and the well had begun to spout. At first the flow was 10,000 barrels per day, which increased to 160,000 in 24 hours, making it the greatest recorded yield per day for any well ever measured.[1] This well stands as a triumph for accurate geological research and the engineering skill shown in quickly bringing it under control by devices which were entirely new to oil-well management. Naturally, the impetus given by this well extended well drilling to all parts of the petroliferous region and brought in companies by the score, where previously the Huasteca and Mexican Eagle companies had been chief rivals in the development of the industry.

While it proved possible to pipe away the oil from Potrero del Llano No. 4 it was not practicable to shut off the flow of oil lest it should seep to the surface beyond the casing. A pipe connection was made causing the oil to flow into a reservoir holding 4,000,000 barrels, and the necessity of the case caused the quick building of a pipe line from Potrero del Llano to Tuxpam Harbor, where a brilliant engineering feat carried the oil in 8-inch pipes laid along the bottom of the Gulf itself out to the open roadstead, where, by a flexible rubber pipe, ships were loaded from tanks on shore. Contrary to predictions as to what would happen to this pipe line during the great northerly storms in this region it has been possible to load in all kinds of weather from 1911 to the present time. The line is supplemented by additional pipe lines to accommodate the great flow of oil from this well. It has continued to the present at practically 25,000 barrels per day. The necessity of providing for the wonderful output of Juan Casiano No. 7, caused the building of a pipe line from the point of production to Tampico. This was followed by a pipe line built by the Aguila Co. to the same point. Large tank farms erected by these two companies on the banks of the Panuco River made Tampico and Tuxpam the two principal ports of export for Mexican petroleum.

## OCCURRENCE.

The map presented with this paper shows the distribution of what may in general be considered oil territory in Mexico. There are other remote regions in Mexico where oil seepages occur, but no commercial oil has been produced. On the other hand, many of the localities colored as oil territory in Tamaulipas and Vera Cruz simply represent leases of land considered favorable for oil. In general, however, they are all within the extreme limits of oil production.

The search for oil in Mexico has been directed to seepages or springs of tar, very thick oil, and masses of solid asphalt, sometimes of great size. The valuable clues to these seepages have been the igneous masses frequently rising as sharp tooth-like peaks. The tar seepages have frequently been found close to these peaks and on all sides of them. In other cases oil has been found, as at Panuco, without either igneous mass or seepage as a guide. Further, it has been shown that many of these masses have not reached the surface.

Degolyer has shown[2] that the sharp tooth-like mass at Furbero, and with which an oil field is associated, is shale made porous locally by metamorphism, and thus affording a reservoir for oil.

[1] Since that date the Cerro Azul well of the Huastica Co. has exceeded the product of Potrero del Llano.

[2] Trans. Am. Inst. Mining Eng., San Francisco Meeting, Sept., 1915.

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The sedimentaries of early Tertiary and Cretaceous age in which the oil has accumulated have been thoroughly described in many articles, especially by Villarello, Órdonez, DeGolyer, Garfias, I. C. White, and Ralph Arnold and others in such detail that not more than a synopsis is desirable here. The Tamasopa limestone (Cretaceous) and the overlying San Felipe formation (Tertiary) have been the chief reservoirs. It is admitted that in many cases the oil has not originated in the rocks furnishing the reservoir, and favorable conditions of structure seem to have been the more important matter. Thus, although the Tamasopa limestone underlies the San Felipe beds in the Panuco field, it has never been reached in the search for oil, all of which has been found in the San Felipe above.

## UTILIZATION.

To understand past and even present uses of Mexican oils it is necessary to consider its composition. Like most oils associated with limetones Mexican oils are, in general, asphaltic. They contain more asphalt on the average than California oils. Exceptions to this are the oils from Tabasco and from the Valles field in San Luis Potosi. These oils are practically free from asphalt, and are like Appalachian oils in most respects. The oils of the Furbero field are also lighter than the others and contain less asphalt and less sulphur.

These oils, usually black, asphaltic, and containing much sulphur, vary in their constituents in a way quite easy to remember. The oils to the north at Ebano and Panuco are very viscous, with a Baume gravity of 10° to 14°—usually 11° to 12°. They contain more sulphur than is found in any other oils. As high as 7 per cent of sulphur has been reported by competent authority[1] from oils in the Tampico region. Usually the oils contain from 3 to 4 per cent of sulphur. V. H. Garfias[2] gives 2.08 per cent as the average from the Juan Casiano gushers.

The oil in the northern districts shows over 40 per cent, and frequently over 50 per cent, of asphalt not volatile at 350° C. and of sufficient consistency to be used for coal surfacing. Farther south, the asphalt, sulphur, and specific gravity decrease markedly.

The oil from Juan Casiano has a gravity of 19.3° Beaumé (0.9376 sp. gr.), while that farther south at Potrero del Llano is slightly lighter. At Alamo, farther south, the oil shows 24° Beaumé, and 27° Beaumé is not uncommon in that neighborhood.

Finally, oil from Tabasco reaches 40° Beaumé and is partly translucent, like some Appalachian crudes. Other oils as far south as the Isthmus of Tehuantepec are very heavy and show much asphalt. It is the exception, however, to find very heavy oils in the south or very light oils in the north.

On distillation, the action of these oils is remarkable. It has been found in general that the heavy oils will give by ordinary distillation from 2 to 6 per cent boiling below 150° C. and classifiable as gasoline. But the oils crack with exceptional ease, and may thus yield 10 to 25 per cent of gasoline and consistently larger proportions of fairly acceptable kerosene. This exceptionally easy cracking is due to the larger proportion of sulphur. The greater the sulphur the easier the cracking. Not only is this a most important feature of these oils, but it was early made use of in the refineries.

Thus, when the Doheny interests were developed in 1901, the old refinery of the Waters-Pierce Oil Co. at Vera Cruz, which had depended upon imported crude, was suspended in favor of a new refinery at La Barra, near

[1] L. von Harder, former chemist Aguila Co.—private communication.
[2] Economic Geology, May, 1915, p. 218.

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Tampico, erected with the purpose of cracking the heavy oil from Ebano. The large amount of asphalt was marketed in Mexico City for paving purposes, and a considerable amount of crude oil was used for fuel by the railroad from Tampico to San Luis Potosi.

The low refining value of the oil caused much of it to be exported for fuel or to be consumed in Mexico for the same purpose. There is no oil on any market which, at first glance, seems so to justify its abuse by burning as fuel under boilers and in every way. But credit must be given to the English Aguila Co. for their enterprise in at once introducing internal-combustion engines of the Diesel type and for preparing oil distillates for their engines, and to the Waters-Pierce Co. for refining the oil even to producing a fine grade of paraffin wax.

When one considers that this paraffin is not usually a commercial product of such very asphaltic oils as these Mexican crudes, it is worth while to consider what other series of hydrocarbons are either contained in Mexican oils or can be obtained by conversion methods.

In general, the oil is one of the most complicated known. It contains in commercial proportions members of the paraffin, olefine, asphalt, aromatic and naphthene hydrocarbons, and it is probable that many polycyclic hydrocarbons are also contained. It is possible that there may be found all the commercial oils found in any crude, and, if not, that these can be prepared by conversion meothds.

Thus, these oils can serve as the basic material for all branches of the petroleum industry.

Such an ambitious outlook throws a responsibility upon the future development of Mexican oil entirely different from its continued use for fuel. Under present practices, one can epitomize the use of Mexican oil by considering it as yielding up to 10 per cent of fairly good gasoline and 10 to 20 per cent kerosene by the liberal aid of cracking. Next 10 to 20 per cent of gas oil, or a smaller percentage of lubricants, can be distilled off, and the residuum can then at best be so manipulated as to leave it thin enough for an inferior fuel oil. Other practice is to distill off only 2 to 6 per cent of gasoline and by the use of steam get off kerosene and heavier products with as little cracking as possible in order to leave asphalt that has enough tensile strength for good pavements.

But consider for a moment the gasoline obtained, and it is seen that, while it distills at the usual temperature for gasoline and is entirely satisfactory for such purposes, its specific gravity is abnormally high, just as is the case with California oil. The reason in both cases is the same. The Mexican and California oils contain both aromatic hydrocarbons and naphthenes. This is very significant for the development of the Mexican industry. Thus it is due to the presence of these ring hydrocarbons that California oils owe their prestige for lubricating and even medicinal oils. It is true that the sulphur in Mexican oils is a drawback in the development of these high-priced products.

Equally significant for further development is the occurrence of aromatic hydrocarbons in these Mexican oils. It is probable that benzol and toluol are practically lacking, but the three xylols are present in commercial quantity as in California. The uses for these xylols are important and increasing. That all these aromatics may be extracted with profit and leave good gasoline and improved kerosene is shown by present practice in Roumania, where, by Dr. Edeleanu's process, the aromatics are easily extracted by liquid sulphur dioxide and applied to the production of aniline dyes and high explosives.

Thus far I have spoken only of the use of constituents of the oils as found or obtainable by the old processes of cracking at the ordinary pressure.



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Turning to what may be expected from these oils when various conversion methods are applied, your attention is called to the great progress which has been made in this direction within the last year by the Bureau of Mines, with the general result that Dr. W. F. Rittman has developed practical results by which crude oil with a given yield of various useful products can be transformed into an oil which will yield any other desired proportion of useful products. Thus, if gasoline is desired, the crude Mexican oil can be so transformed that instead of yielding 2 to 10 per cent of gasoline it will yield 80 per cent or more. Or, if the crude oil contains no gasoline at all, the same transformation can be brought about. Similarly, if kerosene or lubricants or greater yields of aromatics be desired, the same kind of conversion is possible.

Just at this time, and for the near future at least, aromatic hydrocarbons are particularly in demand. Mexican oils are in better position than others, except California, to furnish aromatics, and further, while Mexican oil may, like California oils, be lacking in the more volatile aromatics, it is easier to crack the heavier aromatics to benzol and toluol than to first form aromatics and then crack them, as is the case with Pennsylvania or midcontinent oils. Here is an advantage so manifest that industrial enterprise will not be slow to avail of it.

In making benzol and toluol from Mexican oils there is a large deposition of carbon. This condition of this carbon depends upon the details of the process. The higher the temperature, the harder and denser the carbon. Late experiments have produced the carbon more in the form of soot or lampblack.

Much objection has been made to the enormous waste of heat involved in making lampblack from natural gas. It certainly is worth while for the Bureau of Mines to develop this new source of useful lampblack as a by-product of the Rittman process.

It is seen from the above that the present state of petroleum technology offers to Mexican oil the means of making from it any kind of hydrocarbons that may be most needed.

What promise is there for future advances in the same direction?

In order to show the relations of organic compounds to each other, it is necessary to consider them as derived from one or another hydrocarbon, all of which can be derived from petroleum by extraction or conversion.

Thus sugar, glycerine, fats, butter, starch, and cellulose can be considered as rather simple derivatives from paraffin oils.

Consider the complexity of the new substance, bakelite, and yet how easy it is to manufacture it commercially from carbolic acid and formaldehyde. Tons of carbolic acid are made every month from hydrocarbons obtainable from Mexican oil, and formaldehyde is even more simply made.

Considering further those substances at present capable of synthesis from oils, it may be noted that two years ago it proved possible to make fatty acids from an otherwise worthless emulsion of Mexican oil and water simply by electrolysis, which gave the oxygen of the water to the oil. Since then Mr. T. T. Gray has succeeded in oxidizing paraffin wax by use of the oxygen of the air under the influence of violet light. He converted 85 per cent of the paraffin directly into fatty acids, suitable in place of stearine for soap. There are many other synthetic substances from crude petroleum; and, in fact, in studying the nature of our foods, scientific research has shown their exact relations to hydrocarbons and has pointed out just how they may be produced. It is not difficult to believe that the technologist will rapidly follow the purity scientist in rendering these researches commercial and elevating Mexican oils from fuel to food.

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While the usual development of technologic processes may be relied on slowly to bring about the great improvements in the utilization of Mexican oils which have been referred to above, there is one function which can be served by this congress which can greatly expedite this desired improvement. The industry in Mexico, as everywhere else, but especially in Mexico, suffers from a chaotic condition of the various methods for the examination of petroleum products. No reform is so greatly needed as that of introducing a uniform series of methods for the analysis of crude petroleum, and especially its products. Such a uniform method applied to Mexican oils, and enabling a fair comparison of these oils with others, would aid in making generally known the facts referred to in this paper. Such uniform tests can only be brought into use by the aid of such an international congress as this. I would, therefore, offer the following resolution for the consideration of the Second Pan American Congress:

*Resolved*, That immediate steps be taken for the adoption of methods for the examination of petroleum and its products which shall be uniform for all Pan American countries.

The CHAIRMAN. The hour is a little late, but are there any remarks, particularly on this resolution? If there is discussion on the resolution I believe it should be had at this time, because it is necessary to pass all resolutions on to the sectional chairmen so they can be prepared for the general meeting of the congress next week.

A VOICE. I move it be referred to the chairman of the section with a favorable recommendation.

The motion was put and carried.

The CHAIRMAN. There being no further business, I declare this meeting adjourned.

Whereupon, at 12.50 o'clock the meeting was adjourned.

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## JOINT SESSION OF SUBSECTION I OF SECTION III AND SUBSECTION I OF SECTION VII.[1]

RALEIGH HOTEL,
*Thursday afternoon, December 30, 1915.*

Chairman, VAN H. MANNING.

Papers presented:

The copper mining industry in the Americas, by Walter Harvey Weed.

Mining, metallurgy, and economic geology, by Luis Fleury.

The conservation of copper, by W. H. Emmons.

The conservation of metals by the recovery of scrap or used metals, by J. P. Dunlop.

The possibility of treating by the cyanide process the complex silver or silver-gold ores of the Latin American Republics, by G. H. Clevenger.

Cyaniding in South America, by H. A. Megraw.

Metallurgy of native silver ores on Southwestern Chihuahua, by Walter M. Brodie.

Concentration and metallurgy at the San Antonio Mines, by Miguel Callejas.

Concentration by flotation, by F. G. Fuchs.

### THE CONSERVATION OF COPPER.

By W. H. EMMONS,

*State Geologist of Minnesota.*

#### COPPER RESERVES.

North and South America produce about 72 per cent of the world's copper, about 55 per cent coming from the United States. The available reserves in the Western Hemisphere also are vastly greater than those of the Eastern Hemisphere, and in the future, at least for many years to come, the Old World must look to us for much of its supply of copper. To meet this demand there are fortunately large reserves in the Western Hemisphere that can be mined and beneficiated profitably under present conditions.

[1] There was no stenographic report of this session. The papers of Section VII are found in Volume VIII of the Proceedings of the Second Pan American Scientific Congress.



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*Copper production of North and South America in 1912.*

| | |
|---|---|
| United States | 1,243,268,720 |
| Mexico | 158,760,000 |
| Chile | 83,569,500 |
| Canada | 77,775,600 |
| Peru | 60,858,000 |
| Bolivia | 8,158,500 |
| Newfoundland | 1,102,500 |
| North and South America | 1,633,492,820 |
| World's production | 2,251,311,770 |

In the United States 12 districts produce about 94 per cent of the copper mined. The districts, compared to most precious metal camps, are generally of long life. Though some of them have been worked steadily for more than 30 years, not one has yet shown signs of exhaustion or a decrease in its ability to produce copper.[1]

Lindgren[2] summarizing the copper reserves of the United States in 1908 made the following statement: "Few companies have reserves for as much as 10 years, and only in one case are they believed sufficient for 38 years. Each year will, however, surely find extensions of reserves added to those already discovered, and large new deposits of low-grade copper ores will undoubtedly be opened." This prophecy has been amply justified. Although the annual production in the past seven years has increased over 50 per cent, the reserves to-day are much greater than in 1908; indeed, the so-called disseminated deposits in porphyries and in schists alone have reserves sufficient to keep at the present rate the entire copper production of the United States for about 16 years.

*Total blister copper production of principal districts to the close of 1912, in pounds, and percentage of total of each.*[3]

| | Production began. | Pounds. | Percentage of total production. |
|---|---|---|---|
| Butte, Mont. | 1868 | 5,894,200,000 | 33.44 |
| Lake Superior, Mich. | 1845 | 5,205,700,000 | 29.53 |
| Bisbee, Ariz. | 1890 | 1,555,200,000 | 8.82 |
| Morenci-Metcalf, Ariz. | 1873 | 1,034,100,000 | 5.87 |
| Bingham, Utah. | 1896 | 702,500,000 | 3.99 |
| Jerome, Ariz. | 1883 | 634,880,000 | 3.60 |
| Globe, Ariz. | 1881 | 440,900,000 | 2.50 |
| Shasta County, Cal. | 1897 | 391,900,000 | 2.22 |
| Ely, Nev. | 1908 | 257,300,000 | 1.46 |
| Ducktown, Tenn. | 1850 | 249,055,000 | 1.41 |
| Santa Rita, N. Mex. | 1800(?) | 129,400,000 | .74 |
| Foothills Belt, Utah. | 1862 | 115,500,000 | .66 |
| Tintic, Utah. | 1880(?) | 103,900,000 | .59 |
| Total. | | 16,714,535,000 | 94.83 |
| All other districts. | | 911,325,000 | 5.17 |
| Grand total. | | 17,625,860,000 | 100.00 |

[1] Butler, B. S., Mineral Resources of the United States for 1912, pt. 1, Metals, 1913, p. 291.

[2] Lindgren, W., Papers on the conservation of mineral resources: Bull. U. S. Geol. Survey No. 394, 1909, p. 142.

[3] Butler, B. S., Mineral Resources for 1912; Copper: pt. 1, Metals, p. 291.

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In connection with an estimate of reserves it is necessary to review briefly the nature of occurrences of copper ores. A useful classification for present purposes is one based simply upon attitude. The principal deposits are rudely tabular; some of them are nearly vertical, others blanketlike or flat lying, and others still falling between the two classes are inclined at low angles. Still other deposits are irregular. Those deposits that are flat lying or blanketlike and near the surface obviously may be more readily explored than those that are verticle or dip at high angles, and it is the flat-lying deposits that contain the greatest developed resources. Other deposits may produce as much ore, but less ore in them is now blocked out. The most exact information is available for the disseminated deposits, the so-called "porphyry" ores. Such ores are found below leached low-grade capping, and they extend downward in some deposits several hundred feet below the capping. In general these deposits are fairly uniform in grade, and owing to their blanketlike shape and their regularity they are easily and cheaply explored, and by drilling ore may be blocked out in them without great outlay. Important deposits of this type are found at Bingham, Utah; Ely, Nev.; Morenci, Miami, Ray, and Ajo, Ariz.; at Santa Rita and in the Burro Mountains, N. Mex.; and elsewhere.

Although most of the deposits above mentioned are being worked on a large scale, there are still reserves of ore for many years to come. At Bingham the Utah Copper Co. has 338,000,000 tons of disseminated ore developed that will carry 1.45 per cent copper. Although the company treats over 7,000,000 tons of ore a year, there is ore in sight for about 48 years. At Ely there are 60,000,000 tons of disseminated ore; at Ray, 74,765,789 tons that carry 2.215 per cent copper; at Miami, 133,000,000 tons with 1.80 per cent copper; at Santa Rita, 90,000,000 tons with 1.75 per cent copper; at Ajo, Morenci, and in the Burro Mountains the known reserves, though smaller, are considerable.

In all of the districts in the United States having deposits of this type there are developed about 800,000,000 tons of ore, which, with present milling practice, will yield approximately 20,000,000,000 pounds of copper. In most of these districts there are also deposits other than those of the disseminated ores. These have not been taken into account here, but they also will yield large amounts of copper.

The deposits that are vertical, steeply dipping, or of irregular shape, as stated above, are not so readily explored as the flat-lying tabular deposits. In general they are in regions where the ground is heavy and hard to keep open, and they are not opened very far in advance of mining. Indeed, extensive exploration, though giving useful information in advance, would result in great loss of labor and probably also in some loss of ore. In mining such deposits, instead of blocking out ore large numbers of "working faces" are kept open to assure an adequate supply. At Butte the deposits are large fissure veins complexly faulted. They are reported to be of good size and grade as deep as they are explored, or about 3,200 feet below the surface. Taking into account their size, number, extent, and grade, in the ground that is already explored and the conditions in the bottom levels of the mines, it seems that Butte may produce for many years as much copper as has been produced annually in the past. If the market advances so that lower-grade ore may be worked there would be available at Butte large quantities of material now regarded valueless. At Kennicott, Alaska; at Bisbee, at Globe, and at Jerome, Ariz., the deposits are known to be very large, but exact estimates are not available to me.

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At Ducktown, Tenn., great reserves are available, particularly of low-grade pyritic ores that can be worked profitably by utilizing sulphur fumes for making acid. In Shasta County, Cal., there are at least 2,500,000 tons of ore in sight, and in addition there are about 5,000,000 tons of material near workable grade. Agitation against smelting plants has discouraged prospecting in this region. With a greater demand for sulphuric acid on the west coast these lower-grade deposits will doubtless become important assets.

The deposits of the Lake Superior region are native metal ores in basic lavas and associated conglomerates, occurring on Keweenaw Point, and ores in sandstones and shales, occurring in Porcupine Mountains, Ontonagon County. These deposits up to 1912 had yielded about 5,205,700,000 pounds of copper since operations began in 1845. The principal productive area extends northeast-southwest for about 70 miles and is less than 2 miles wide. The ore varies from 0.6 to nearly 2 per cent, and owing to the occurrence of the copper as native metal the process of beneficiation is simple. Several of the beds carry workable copper deposits and some of the mines are opened about 1 mile below the surface. The amount of ore actually developed is probably greater than that of any of the districts of the United States except in some of those containing disseminated deposits. In 1911 J. R. Finlay, appraiser for the Michigan State Tax Commission, estimated that these deposits contained 2,681,000,000 pounds of recoverable copper. His estimate was based on a price of 14 cents a pound, and no reserves were credited to unprofitable mines. Since Finlay's estimate was made the mines have yielded 743,223,388 pounds of copper. It is stated on good authority that a reestimate, using the same assumptions and the methods employed by Finlay, would probably show reserves not smaller than they were in 1911. In addition to the ore remaining in the mines there are great bodies of tailings that are being reworked for copper.

Finlay's estimate did not take into account the Nonesuch lode. This lode, at White Pine, Ontonagon County, is now producing copper and recently has been drilled to depths 1,000 feet or more below the surface. The values appear to be persistent, and the future of the region is promising. It is conservatively estimated that not less than 600,000,000 pounds of copper have been developed by drilling on the Nonesuch lode. There are many lodes in the Keweenawan region that are too small or too low grade to work under present conditions. There are also great quantities of material carrying less than 15 pounds of copper to the ton that can be worked profitably when the price of copper warrants it.

In the Western Hemisphere outside the United States several deposits of copper ore have lately been discovered. Within the past few years great additional reserves of nickel-copper ore have been developed at Sudbury, Ontario. Ore bodies have been found that are greatly in excess of those mined out in the same period. Reserves amount to 70,000,000 tons that contain 2,000,000,000 pounds copper. In British Columbia new mines have been opened up as old ones approached exhaustion. Two companies, one operating in the Boundary district and one at Princeton, B. C., have 30,000,000 tons of ore developed, which will carry about 1.6 per cent copper. In Mexico the reserves of copper ore are known to be large, and more stable political conditions would result in greatly increased production. In South America great ore bodies have been opened up in recent years, principally in Chile and Peru. At Cerro de Pasco and Morococha, in Peru, large bodies of copper ore are developed. I have no exact information as to their size and value. Near Rancagna, Chile, the Braden Copper Co. has developed reserves which its officers estimate to contain 113,694,880 tons, averaging 2.50 per cent copper. At Chuquicamata the deposit

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of the Chile Exploration Co. is estimated to contain 303,300,788 tons of "probable" and "possible" ores carrying about 2 per cent copper. Further estimates indicate that the ore body may yield 400,000,000 tons of about that grade. Other promising districts in Chile, Bolivia, and Peru are being explored.

As previously stated, the Eastern Hemisphere is not so well supplied with copper as the Western Hemisphere. There are, however, great reserves of both high-grade and low-grade ores. Japan is the principal producer, but large amounts are mined also in Spain, Russia, Germany, Serbia, and in Australasia.

The largest reserves are probably at Rio Tinto, Spain, at Mansfield, Germany, in Japan, in Russia, and in the Belgian Kongo. If reports of its reserves are accurate, the Belgian Kongo has the largest deposits of high-grade ore in the world.

Summing up, there are 10 mining districts in North and South America that together have deposits developed sufficient to supply the world's requirements at the present rate for about 16 years. There is a reasonable assurance that the copper ore developed and that reasonably sure to be developed, in all of the known deposits will last at the present rate of production at least 40 and probably 100 years.

New districts will certainly be found. Prospecting for copper deposits requires capital. Most of them are not so clearly exposed to the explorer as deposits of iron, gold, silver, and some other metals. A large proportion of the deposits are concealed below low grade or barren capping, and in many districts expensive operations were necessary before discoveries were made. The American Cordillera from Alaska to southern Chile is a great territory complexly intruded by igneous rocks. In it here and there are found great copper deposits. Although most of it has been explored it has not yet been thoroughly prospected. The basic lavas and associated sediments of the Keweenaw region, and the sandstones and shales of Porcupine Mountains region, the border of the Sudbury laccolith, the limestone lenses in the schists of the Appalachian region—all may yet reveal large deposits when they are better known.

If the price of copper should permanently increase, reserves would be increased enormously. If copper were to remain at 25 cents a pound through a term of several years much ore with not more than 1 per cent copper could be mined and milled. Hundreds of deposits too small to justify smelting or milling plants and now practically valueless would become productive, because the ore could be shipped to smelting centers at a profit. Low-grade ores, old tailings, slag, and waste dumps would then contribute enormously to production.

### WASTE.

There may be waste in mining of copper ores, waste in beneficiation of the ores, and waste in utilization of the product.

At present there is some waste in mining copper, but this is less than is the case with many ores of other metals, except iron. The greater percentage of waste is likely to be in mining of small, irregular ore bodies, especially those of the replacement type, or where the ore fades out gradually into the country rock and boundaries are not distinct. In all of the larger districts in the United States where mining is done by underground methods, and where the deposits are irregular or faulted, accurate geologic maps are employed and the levels are thoroughly explored before they are abandoned and allowed to collapse. This practice results in saving ore that otherwise would be lost. In working the great disseminated deposits there is practically no loss in mining except on the margins of the deposits, for nearly all of the material mined

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goes through the concentrators, and the leached copper ore and low-grade material that can not be treated at a profit is generally segregated in the dump piles, so that it can be worked in the future if improvement in practice or the price of copper justifies the operation. The cost of mining is an important factor in the utilization of the low-grade ores. In recent years costs have been greatly reduced. The lowest costs are obtained in those deposits that are stripped and mined with steam shovels, but very low costs are obtained also in underground mining of certain large deposits where the ore breaks up readily into small blocks and fine material. These are mined from the top downward by removing successive horizontal slices from the top, and the surface is allowed to collapse except at the mining faces. It has been found that it matters little what happens to the ground above so long as the miners have good ground to stand on and so long as the rock immediately over their heads is held up. The reduction of the number of accidents by the so-called top slicing methods has made mining much less hazardous to the men employed. The cost of mining has been decreased simultaneously with increased safety. Block caving methods also have proved successful in mining some deposits.

In the beneficiation of the copper ores there are considerable losses. In the concentration of some of the disseminated deposits the saving is between 65 and 70 per cent. Although the losses appear to be high when expressed in percentage of product, the grade of the ore is so low that the tailings carry relatively little copper. The tailings of the porphyry ores of the Bingham district, Utah, carry less than one-half per cent copper.

The losses in the tailings should not be considered ultimate losses, however, for the tailings are being stored in practically all of the plants of the country, and with higher prices for copper and with improved milling processes they will be reworked. Indeed, within the past year improvements in practice have been announced that justify the prediction that the saving of these ores will be increased and that tailings impounded from former operations will be reworked with large additional savings.

To-day more rapid progress in the beneficiation of copper ore is being made than ever before. The oil flotation process and the leaching process both promise greatly to increase the percentage of saving. In the flotation process sulphides carrying the valuable metals are involved in a soapy froth that is skimmed off the watery slime mechanically with small additional cost. A much higher extraction is secured than formerly was done by the simple gravity methods alone. This process is just now coming into general use, and as is the case with many new processes it is likely to show rapid advances in the future.

With the increase of industry the demand will become greater for sulphuric acid, large quantities of which are used in practically all of the chemical industries. Improved agriculture will require phosphate in increasing quantities, and for this to be made available in a concentrated form the use of acid is essential. Pyritic ores that are not profitable when treated for copper alone will become valuable when utilized for both copper and acid, or for copper, acid, and iron, as is possible where some processes are employed. It appears certain that in the future sulphuric acid will be used more and more for leaching low-grade oxidized copper ores, of which there are large quantities easily available for surface mining. The success of the processes for leaching these ores seems to be assured for regions where sulphide ores also are present and where the outlay for building acid plants is justified. Ores containing much lime carbonate can not be successfully leached with acid on account of high consumption of acid; but such ores containing copper as native metal may be treated with ammonia. The process is being employed on a commercial scale and will add great reserves to the world's available copper.

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The losses in smelting copper are low with the best practice; commonly less than one-fourth per cent of the copper is carried off in the slag. Losses in flue dust have been greatly reduced by the Cottrell process. The present smelting losses are so small that there is little prospect for much improvement of the present practice except by lowering costs.

Waste in the utilization of copper is small under normal conditions. Unlike iron, copper weathers very slowly, and the losses due to oxidation are almost negligible. On trolley wires there is some loss by abrasion, and there is a small additional loss in remelting and reworking the worn cables. The use of sheet copper for protecting structures from the weather results in some loss, but these losses are relatively small because of the long life of the sheets. Ultimately, when they are no longer serviceable because of oxidation, the sheets are removed, but much of the copper in them is recovered by smelting the weathered material. The recovery of copper from scrap will increase as the use of copper increases. It is now an important item. Probably the greatest losses of copper are in making alloys which commonly are put to uses that result in certain loss. Much copper is used in making fittings for battleships and munitions of war, and such loss appears unavoidable.

### SUBSTITUTES FOR COPPER.

The principal uses of copper are noted above. The greatest quantities are used for transmitting electricity, for making alloys, and for protecting marine vessels and houses from decay. For transmitting electricity the chief substitutes or competing metals are iron and aluminum. Where tracks may be carried on the ground steel rails are used successfully instead of copper, and many electric systems, especially those of elevated railroads, use steel for transmission. The reserves of iron ore of the world are great compared with those of copper, and as copper advances in price iron will be used more and more for electrical transmission for trolley lines. But for overhead transmission, owing to its great weight, iron probably will never be substituted for copper to any great extent. Aluminum, owing to its great strength and light weight, is now being used on some power lines. Lighter cables and fewer poles can be used, and this may result in saving cost, especially in regions remote from markets where saving in freight may offset the greater cost of aluminum over copper. The cost of aluminum per pound is higher than that of copper. That is not because aluminum is rare but because it costs more to recover aluminum from its ores. Aluminum is indeed the most abundant metal in the economy of nature. It is almost twice as abundant as iron and many times as abundant as copper. It is difficult, however, to separate from other elements —oxygen, silica, etc.—with which it forms compounds in nature. It is now recovered from bauxite, the oxide of aluminum. The known reserves of bauxite, at least in North America, are small compared with those of copper, and as long as the present metallurgical practice obtains, unless important discoveries are made, the amount of aluminum available for the transmission of electric power is not likely to affect seriously the amount of copper required for that purpose. But aluminum silicates are very abundant, and several patents have been issued to recover aluminum from silicate combinations. If any of the processes covered were perfected to the point where aluminum could be produced at low cost from the silicate minerals, the use of aluminum for electrical transmission would increase more and more. In the distant future, when copper reserves have come nearer to the point of exhaustion, necessity for cheap aluminum will probably stimulate the perfection of processes for re-

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claiming the metal in greater quantities. Aluminum could be substituted also for copper in some alloys and for sheeting certain structures to preserve them from decay.

SUMMARY.

In conclusion it may be stated that the ore that is blocked out and that reasonably certain to be developed in mining districts of North and South America which are now producing copper will last, at the present rate of consumption, about 40 years. With moderate success in prospecting these districts should yield copper at the present rate of consumption for 100 years. The discoveries in new districts and discovery of copper ore in districts where other metals are now being mined will probably be large. Because copper deposits are commonly leached at the surface many have doubtless been overlooked. Owing to recent advances in mining and in concentration, larger recoveries are being made to-day than formerly. Low-grade ores will be worked more and more, and if there should be a substantial and permanent increase in the price of copper much material now considered waste could be worked.

No method occurs to me by which the conservation of copper can properly be furthered by legislation. Great progress is now being made in avoiding waste, especially by the companies that are exploiting large low-grade deposits. The present losses are principally in the concentration of the ore. Though these are large the tailings are preserved and much of the material will doubtless be reworked in the future. The developments of the acid leaching process and of the oil flotation processes have greatly improved the situation within the past few years. All of these improvements will make it possible to treat ores which have been considered valueless; indeed it is the advance in mining and in milling practice that has added so much to the copper reserves in the past 10 years, because material which had been considered worthless has become valuable.

I wish to thank the many officers of mining companies who have supplied much of the data utilized herein, especially that relating to estimates of ore reserves.

## CONSERVATION OF METALS BY THE RECOVERY AND USE OF SCRAP METALS AND DROSSES.

By JOHN P. DUNLOP.

*United States Geological Survey.*

For many years statistics relating to metals have been collected and published by the United States Geological Survey, by various State surveys, and by mining journals. These data, however, were almost entirely confined to primary metals; that is, those derived directly from ores. It was known to the metal interests that considerable and increasing quantities of scrap metals and drosses were available for consumption, but it is doubtful whether even those handling metals had any adequate conception of the quantity of this secondary material. The general public, and even those persons actively engaged in metal mining, notwithstanding the publication by the United States Geological Survey for the last six or seven years of the recovery of secondary metals, still have little idea of either the quantity or the value of old materials, of which metals are only a part. That the value of the old iron, nonferrous metals (copper,

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lead, zinc, tin, etc.), paper stock, rags, rubber, bones, leather, bags, collected and reused in 1913 or 1914, was considerably greater than the total value of all the gold and silver produced from mines in the United States in either of those years, is not generally known.

There is nothing romantic in the collection of junk or waste, nothing picturesque in the appearance of the usual itinerant gatherer of old iron and worn-out copper utensils, with his dilapidated outfit. He was formerly received with derision and was looked upon as a disreputable, if not dishonest, dispenser of unreliable tinware. Naturally most people never did, and do not now, consider this perambulating junk collector as a representative of a large and ever-growing industry. At one period, however, his labors were undoubtedly responsible for the collection of a considerable part of the output of old (secondary) metals; but as manufacturing and railway interests have expanded the collections of the itinerant peddler have declined to a relatively small percentage of the total trade in used metals. There are now many prominent and responsible dealers and refiners of scrap metals, and there are many plants treating secondary material exclusively which compare favorably in size and in the quantity of their output with the large smelters and refiners treating ores.

The approximate value of all waste materials is not known, for there has been no effort to obtain statistics other than that made by the United States Geological Survey and by it for only a few of the more important nonferrous metals. The inquiry by the survey was first undertaken by Mr. C. E. Siebenthal, in 1907, to supplement the reports on lead and zinc in order that stocks of metal available for consumption might be more definitely ascertained. The scope of the survey work did not permit any discussion of the technology of the use and adaptability of secondary metals, but the statistics collected were regarded as essential, and the inquiry has been extended until the statistics of the recovery of secondary metals now include copper, lead, zinc, tin, antimony, and aluminum.

"Secondary metals" are those recovered from scrap metal, sweepings, skimmings, drosses, and are so called to distinguish them from the metals derived from ore, which are termed "primary metals." The distinction does not imply that secondary metals are of inferior quality, for metals derived both from ore and from waste material vary in purity and adaptability for use in making certain products. The reports to the United States Geological Survey do not include the large quantity of iron and steel remelted, neither do they include old nickel, gold, silver, and platinum. In fact, although the data relative to copper, lead, zinc, aluminum, tin, and antimony cover a large field and form an essential addition to the reports on primary metals, the scope of the inquiry probably reveals by less than one-half the extent of the trade in waste metals. The value of the old iron and steel reused amounts to many millions of dollars annually. The United States assay offices and the private refineries recover large quantities of gold, silver, and platinum from old jewelry, sweepings, and photographic and dental waste. Only a small percentage of secondary metals is derived from old stoves, copper bottoms, and other household utensils. The manufacturing and railway centers contribute the bulk of the metal wastes, and when general trade and transportation are dull, fewer plants are scrapped and less babbitt and bearing metals are necessary in operating, and consequently the production of scrap metal and residues declines.

Although junk dealers and collectors frequently pay low and apparently inadequate prices for small quantities of scrap metals, competition results in good prices being obtained for carefully sorted scrap and other waste-metal

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products sold in large quantities. On several occasions the writer has been told by purchasers of zinc drosses and skimmings that competition had forced prices so high as to subject the purchasers to considerable losses. After remelting or refining, the secondary metals are sold at prices equal to or only slightly lower than prices for new metal. These secondary metals displace an equivalent quantity of primary metals and must be considered in any estimate of stocks available for consumption in any year. For a few purposes requiring especial purity of material it is necessary to employ primary or virgin pig metal, but as a general rule secondary metals can be used in whole or in part. In fact, most foundries, in order to compete for business successfully, must use secondary material at least in part, and hence scrap metal is purchased by them and remelted with primary pig metal or with composition ingot. The secondary smelters, by handling large quantities of all kinds of scrap, are able to classify their material so as to produce continuously alloy metals of uniform composition suitable for use in work for different purposes. Such composition ingots are being purchased and used in increasing quantities by many foundries and other manufacturers in place of primary metals or of mixtures of new and scrap metals. There has been a notable increase in the use of magnetic separators to obtain scrap free from iron filings, and at some plants concentrating tables have been introduced, by means of which cinders and molding sand from brass foundries containing as little as 2 per cent of metal were treated successfully. The general tendency is to save all waste metal of every kind and obtain more for it by better grading and classification. Copper wire and heavy copper and brass scrap are kept separate from light copper and brass, and small scrap is briquetted in order to reduce the loss in remelting. Few metallic articles are wasted; old clocks, bases of electric lamps, light wire, and steel springs are all gathered and sold, though such articles are not desirable scrap and have a limited market compared to heavy copper, brass, and babbitt.

Many foundries and metal-working plants now employ chemists, and careful attention is given to the analysis of metal wastes and also to the segregation of scrap borings and linings. Several of the metal trade journals publish information relating to the proper method of segregation of scrap and to its proper use for various purposes.

The method in most common use is to segregate the scrap according to composition, to melt it in quantities large enough to obtain homogeneous lots, to pig it, analyze it, and to use it with the proper addition of virgin metals in the manufacture of the alloy which it most nearly approximates. As manufacturers and dealers in old metals become more familiar with the standard classification of old metals adopted by the National Association of Waste Material Dealers there will probably be better grading of material, fewer disputes, and higher average prices paid for scrap.

It has so far proved impossible to separate the statistics for secondary metal recovered from clean scrap made in the ordinary course of manufacture from the statistics of metal recovered from drosses and skimmings and from scrap or old metal that had entered the trade as manufactured articles and been discarded. An estimate has been made of the clean copper and brass scrap, but no distinction is made by many of the dealers or smelters.

It is not claimed that available statistics relating to secondary metal recoveries are other than approximate, though it may certainly be assumed that the quantities reported are less than the quantities actually recovered. Some idea of the extent of the industry is obtained from the fact that the estimated value of the secondary metals, exclusive of iron, gold, silver, and platinum, amounted

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to nearly $72,800,000 in 1913, and, notwithstanding slackened trade conditions and low prices of metals, to more than $57,000,000 in 1914.

The total quantity of secondary copper recovered in 1914, on the assumption that the brass remelted had an average copper content of 70 per cent, was about 127,800 tons, of which 16,000 tons was recovered by plants refining primary metals and the remainder by plants treating only secondary materials. The copper produced by smelters of the latter class includes 36,600 tons of pig copper, 5,900 tons of copper in alloys other than brass, and 69,300 tons of copper in remelted brass. At least 40,000 tons were recovered from clean scrap made in the course of manufacture of copper and brass ware, so that about 77,800 tons was obtained from ashes, cinders, and scrap, or from material that had actually been used and discarded. According to the United States Bureau of Foreign and Domestic Commerce, the exports of scrap brass fit only for remanufacture for the calendar year 1914 were 10,420 tons and the imports were 2,565 tons. Many railways sell or turn in the larger portion of their brass and copper scrap and other metal waste to dealers in part payment for new material, but the reports received show that the railways utilized in their own shops and foundries more than 12,000 tons of brass, in addition to 700 tons of copper and 1,362 tons of copper in alloys other than brass.

The production of copper from secondary sources in 1914 was equal to 16.7 per cent of the refinery output of primary copper in the United States from all sources, or about 22.2 per cent of the primary copper smelted from domestic ore.

The secondary lead recovered in 1914 amounted to 61,000 tons, or about 11,800 tons less than in 1913. The recovery of secondary lead made by those smelters whose product is mainly primary metals was slightly more in 1914 than it was in 1913. The decrease in both pig lead and lead in alloys was undoubtedly due to slackened conditions in building operations, railroad traffic, and manufacturing. A large portion of the recovered lead in alloys was derived from old babbitt, solder, type metals, and white metal drosses. The main sources of secondary pig lead are old pipe, lead cable, battery lead, and lead lining of acid tanks. The regular lead smelters and refiners working on lead from ores frequently find it advantageous to use material from secondary sources, and in 1914 they reported the recovery of 11,100 tons of lead from scrap lead and scrap antimonial lead. It is probable that the actual quantity of remelted lead was considerably in excess of 61,000 tons, for scrap lead can easily be remelted and used.

The total reported output of secondary lead was equal to 11.3 per cent of the primary refined lead produced in the United States in 1914, compared with 15.2 per cent in 1913. It was exceeded by the primary domestic output of lead in only three States—Missouri, Idaho, and Utah.

The output of secondary zinc (including that in brass) amounted to more than 71,600 tons and equaled 20.3 per cent of the production of primary spelter in the United States in 1914, compared with 23 per cent in 1913. The recovery was about 8,000 tons less than in 1913, of which decrease more than 5,000 tons was the loss in redistilled zinc from drosses and skimmings. The zinc recovered in alloys other than brass amounted to about 3,900 tons, compared with 3,700 tons in 1913. Of the 42,969 tons of secondary zinc recovered as pig zinc, 20,545 tons were obtained by redistillation from drosses and skimmings. Of this quantity 6,580 tons were obtained by smelters whose principal source of zinc is ore. In addition to the 31,723 tons of remelted and redistilled spelter it is estimated that at least 8,000 tons of zinc chloride was made and likewise about 32,800 tons of the zinc pigment lithopone (containing approximately 32

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per cent zinc sulphide and oxide). The zinc used in both of the last-named products is derived almost altogether from zinc drosses and skimmings. The exports of zinc drosses, which only amounted to 28 tons in 1913, increased to 2,526 tons in 1914.

Three smelters in New Jersey, New York, and Pennsylvania, which treat only drosses and skimmings, use large graphite retorts of 600 to 800 pounds capacity instead of the small clay retorts used by smelters treating ore or mixed ore and drosses. The various uses of zinc drosses and skimmings create active competition for their purchase. Considerable zinc is recovered from zinc wastes by "sweating," and the residues are then sold for redistillation. The secondary zinc varies in quality just as the zinc derived from ore does, but a large portion of the secondary zinc is reported to be of excellent quality.

The production of secondary antimony, of which practically all was recovered in alloys, decreased from 2,705 short tons in 1913 to 2,646 tons in 1914. The only antimony ore of domestic origin smelted in the United States in 1914 was about 60 tons from Mill City, Nev., which was mined in 1907. The regular smelters reported the recovery of 140 tons of antimony contained in antimonial lead scrap. The principal materials refined or remelted which contained antimony as an alloy were hard-lead drosses, babbitt, solder, pewter, and type metal. The imports in 1914 of antimony as metal in ore or as oxide, amounted to 7,528 tons, and the recovery from secondary sources was equal to 35.2 per cent of the imports. The secondary recoveries of antimony were 117 tons more than the antimony content of lead ores of domestic origin smelted in 1914.

Apparently there were no domestic tin ores smelted in the United States in 1914, though some tin concentrates were shipped from Nome, Alaska, to Singapore, Federated Malay States, for treatment. There was considerable agitation for the smelting in the United States of both Alaskan and Bolivian tin ores, and an increased output from Alaska may result in establishing a tin smelter on the Pacific coast. This lack of domestic production makes secondary tin an important factor in supplying domestic consumption. The secondary tin recovered in 1914 was equal to 26.2 per cent of the tin imported, as metal or as oxide, into the United States during the year (47,525 short tons). Secondary tin recoveries decreased from 14,200 tons, valued at $12,567,879, in 1913, to 12,400 tons, valued at $8,887,158, in 1914. The quantity recovered as tin was 4,500 tons and that recovered in alloys and chemical compounds 7,900 tons. The value of the recovered tin here given is arbitrary and is based on the yearly average price given by the American Metal Market. It will be noted that the secondary tin in alloys increased about 150 tons, and that the secondary pig tin decreased about 1,900 tons, a condition partly attributable to the large quantity of tin chloride made from clean tin scrap.

The recovered tin in alloys includes the tin content of products of several plants made from clean tin scrap and from tin liquors used in dyeing or weighting fabrics. This included some tin oxide, putty powder, but consisted mainly of tin chloride. The production of these compounds is calculated as metal and not separately stated, in order to avoid disclosing confidential information. As the products are made from scrap tin and thus conserve the primary metal, they are properly regarded as recovered tin. Two forms of tin chloride are handled commercially—stannic and stannous salts. Stannic chloride is usually sold either as a water solution, called bichloride of tin, or as an anhydrous sirupy liquid, termed tetrachloride of tin, and is used principally in the silk industry. Stannous chloride is sold in the form of crystals and is used in both dyeing and printing calico. The dry chlorine process was used in some plants

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to recover the tin from the clippings. At other plants reverberatory furnaces were used to remove the tin coating, and a large quantity of tin was recovered in the form of a tin powder by the electrolytic treatment of clean scrap, the powder being sent to secondary smelters. Formerly considerable clean tin scrap was exported, but it is stated that keen domestic competition has resulted in practically all such scrap being used in domestic plants. The largest recoveries of tin were made from the scruff and drosses that occur in making tin and terne-plate and amounted to more than 4,000 tons. The quantity of tin recovered from tin foil is declining rapidly, and the secondary tin from foil and also from old block tin pipe is a very small part of the total recoveries.

The recovery of the tin coating from old used cans has attracted the attention of many persons, and more inquiries have been received relative to that phase of secondary metal conservation than to all the other metals combined. There is no lack of material for such an industry, which would assist in recovering the most conspicuous component of many an unsightly dump, but such would-be benefactors have invariably decided that this particular improvement of the landscape was not apt to prove a profitable investment.

During the last four years only one firm has reported recoveries from old tin containers, from which the tin and solder were first sweated and the black plate was then remelted to make sash weights. Comparatively large quantities of tin scrap and old tin cans are used in the western mining regions for their iron content in the precipitation of copper from mine waters. However, the tin coating of the scrap does not enter into the reaction and is lost entirely. It is not possible under prevailing conditions of low prices for tin and of stagnant market for the scrap black plate to utilize old used tin-coated containers for the recovery of the tin. The ordinary can used for food seldom carries more than 2 to 2.5 per cent of tin coating, and gasoline cans and tin buckets have a much lighter coating. It is stated by operators of detinning plants that there has been a decline in the thickness of the tin coating on much of the tin plate marketed, and also that the selvage on the sheet tin plate has not the extra thickness of coating it formerly had. The principal alloys in which secondary tin was recovered were solder, bearing metals, bronze, pewter, and electrotype metal.

The more extended use of aluminum during the last few years in the automobile industry, in the brewing industry, and in the preparation of foodstuffs and chemicals has resulted in a large increase in the recoveries from scrap and skimmings. The recovery of secondary aluminum as pig aluminum or in alloys amounted in 1914 to 4,500 tons, or 13 per cent of the domestic consumption of aluminum in 1914. The quantity recovered in alloys amounted to 1,700 tons, nearly all of which was an alloy of 92 per cent aluminum and 8 per cent copper. Most of the secondary aluminum was recovered from clean clippings and borings and was probably all used in making castings. It is stated on good authority that aluminum remelted from clippings can not be utilized for sheet aluminum. The reason is believed to be that a layer of superficial oxide is formed on the sheet and causes planes of separation in an ingot made from clippings. Such ingots when rolled will crack.

Undoubtedly, it is a fact that the scrap material available and utilized in the United States forms a relatively higher percentage of the total metal consumption than it does in any other country. This is because of the rapid expansion of manufacturing and the universal tendency to scrap obsolete plants and processes. The large growth of the cities also makes the demolition of substantial buildings necessary in order to provide additional houses, lofts, factories, and stores in restricted areas and also to yield rentals commensurate

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with enhanced land values. These conditions are largely responsible for the greater percentage of secondary recoveries as compared with those in other countries.

It is a normal development that as a country grows older the raw products advance in price owing to the gradual exhaustion of the sources of the materials. To a certain extent this tendency is counteracted by the improvement in processes which render lower-grade ores available. As prices advance the corollary tendency to save all possible waste and prevent loss of material develops. To gather and use the wornout waste and scrap metals and thus to help to conserve the supply of metals for future generations is the function of all in the waste-metal industry, and even the humblest junkman is a spoke in the wheel of progress.

68436—17—VOL III——18

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## JOINT SESSION OF SUBSECTION 4 OF SECTION III AND SUBSECTION 4 OF SECTION V.

RALEIGH HOTEL,
*Thursday afternoon, December 30, 1915.*

Chairman, M. O. LEIGHTON.

The session was called to order at 2.30 o'clock by the chairman.

Papers presented by Section V:

Engineering work of the United States Reclamation Service, by A. P. Davis.

Irrigation and drainage, by F. H. Newell.

Papers furnished by Section III:

The irrigation work of the Indian Office, by W. M. Reed.

The use of irrigation waters as sources of power, by George G. Anderson.

The CHAIRMAN. The subject of discussion of this joint session is "Irrigation and drainage." We will begin with the reading of Prof. Newell's paper on "Irrigation and drainage." I will ask Mr. John S. Conway, deputy commissioner of lighthouses, to read the paper.

### IRRIGATION AND DRAINAGE.

By F. H. NEWELL,

*Professor of Civil Engineering, University of Illinois.*

#### OBJECT.

The increase of territorial area is the dream of many an ambitious statesman. To bring about such increase without encroachment on neighbors seems to be a contradiction of terms; yet in a proper sense it can be and is being done. The civil engineer is creating new and valuable agricultural areas and making opportunities for self-supporting citizens in localities where up to this time there has been merely waste space. He is doing this through the planning and construction of irrigation and drainage works. He is thus adding not merely to the material prosperity of the country, but more than this, he is increasing the opportunities for better citizenship, for greater health and comfort, and for the enjoyment of many of the higher ideals of life. He is bringing about an internal expansion of usable territory far more valuable than the mere extension of external boundaries.



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This internal expansion is in effect the putting into practice of the principles of conservation, a term which has been much abused, but which really implies good business management, or common sense applied to the use of natural resources. The engineer, finding that certain areas are neglected or that agriculture is not being practiced to its highest efficiency, knowing also that the soil is fairly good and that the climate is adapted to the production of crops, naturally inquires into the reasons. He tries to ascertain the cause for the lack of full use of the lands. This he discovers is usually connected with an excess or deficiency of water supply. The plants useful for mankind are adapted to a relatively wide range of soil and temperature, but are more narrowly limited by the quantity of moisture. The water content of the soil for success with most cultivated plants and grasses can not rise above 18 per cent nor fall below 8 per cent for any considerable length of time. The control of the water, while in part an agricultural operation, is largely dependent upon the application of engineering principles.

Knowing, for example, that a certain area is arid and desert, or subject to periodical drought, the first consideration of the engineer is to seek out the sources from which water may be obtained and brought to the land to raise the water content of the soil from the original condition of from 1 to 2 per cent up to 10 per cent or more.

On the other hand, finding a neglected or abandoned swamp or overflowed area or one whose soil is habitually wet or heavy, the problem presented to the engineer is to take away this excess and bring the water content down from the saturated condition to 15 per cent or less of water.

These two operations are intimately connected because of the fact that when water has been provided in abundance for a piece of arid land, the tendency is to use the water in excess and to saturate it to an extent such that a large part of the area is injured for agricultural purposes. It thus becomes necessary to provide means for reclaiming these saturated lands; drainage is requisite in localities where in their original state the lands were dry and barren.

Irrigation and drainage are thus related, much in the same way that city water supply and sewage are connected. The better the water supply, the more complete should be the sewage system. The larger the supply of water for irrigation the more necessary the installation of effective drains and waste-ways.

This very simple relation has very frequently been overlooked, or at least ignored, to an extent such that throughout arid North America 20 to 25 per cent of the irrigated lands have been ruined by careless handling of the water and by lack of drains. The surface has been converted into swamps or covered with alkali over tens of thousands of acres—once producing large crops under irrigation.

### METHODS.

The way in which the beneficial results of "internal expansion" are being accomplished is through the building of works, big and little, for storing waters which would otherwise flow to waste, and holding these as money is held in a bank until most needed, or, in the case of drainage, the engineer is providing proper outlets by which the excess water may be quickly discharged from the fields into natural depressions leading to the rivers and finally into the lakes or oceans, taking water away from the localities where it is a nuisance rather than a benefit.

In this work are employed many of the principles and much of the latest machinery of modern engineering. The civil engineer, so called, ascertains the

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larger facts and lays out the project. He calls to his aid the mechanical engineer in the devising of machinery for excavation of canals or tunnels or for building dikes and dams. The electrician also is largely consulted for the creation and transmission of electrical energy for operating this machinery. Even the mining engineer has a part in assisting in the construction of tunnels or subterranean works. In fact, there is hardly a branch of knowledge which is not levied upon, directly or indirectly, in these operations which have for their final result the improvement of opportunities for the making of farms and homes.

### SURVEYS.

The first work to be done is to initiate thorough surveys and examinations of the country to be reclaimed or irrigated. These afford the firm foundation of fact upon which the imagination of the engineer may erect in broad outline the results to be attained. As a rule too little care and expenditure has been devoted to this fundamental matter. There is usually impatience for immediate conclusions and an unwillingness to expend any considerable amount of time and money in these early or preliminary surveys. It is safe to say, however, that within reasonable limits it is hardly possible to spend too much money on ascertaining the facts of topography, water supply, soil, and climatic conditions. For every dollar thus wisely expended, it may be possible to save tenfold in future construction and operation. If there is any one thing which characterizes the reclamation work of the past and which has led to the large percentage of financial failures, it is the fact that too little time and money was allowed for these early surveys.

There is a wide range of conditions to be studied. Presumably, the general location of the lands to be benefited is fixed; but the precise outlines are usually unknown. The question of water supply available for these lands is usually undetermined, or the amount of water which must be removed by drainage is in doubt. Both of these matters involve a wide difference in possible quantities; and without having a fairly accurate knowledge of these quantities, money may be wasted either in building works too large or too small. The early surveys, therefore, having outlined the lands under consideration, should go into the question of the quantity of water to be handled with extreme care, ascertaining the probable limitations and fluctuations, both in time and in quantity.

In case of irrigation works deriving their water from the high mountains or from rolling foothills, it may be necessary to have a more or less complete topographical map of the catchment basin to ascertain the extent and character of the slopes and to acquire data as to the floods or droughts which may be anticipated. In some countries, as in the United States, good contour topographical maps have been made of many of the catchment basins. These are invaluable in the consideration of the entire project and in the limitations which may be set upon it.

The study of the catchment area and topographical maps showing the principal features tributary to a reclamation project will usually reveal opportunities for water storage. There may be a number of alternative opportunities presented. The merits and limitations of each of these should be carefully studied, not only by maps but on the ground itself and with particular reference to underground conditions, such as the probability of securing safe and tight foundations for dams.

### EXAMINATIONS.

The topographic surveys of the country from which water may be obtained for irrigation, or of lands to be benefited by such irrigation or by drainage,

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must be supplemented by a variety of examinations of many related conditions. The best probable location of the works having been determined by field and office study, examinations should be made of the character of the ground covered or traversed by the works to ascertain the probable cost of excavation of the different materials encountered, the porosity of the soil, its ability to hold or deliver water, or to sustain structures of heavy weight. For example, if a canal should be built along a hillside, especial study should be made as to the practicability of constructing this in the ground or in flumes. Its safety from earth or rock slides, either into the canal or of the entire structure itself, must be the subject of study.

Throughout the entire area to be irrigated or drained both the soil and particularly the subsoil should be examined with reference not only to the probable fertility of the surface soil, but also as to the density of the subsoil and its behavior with reference to percolation of water into or out of it. The examinations thus lead into a variety of lines not merely confined to the apparent agricultural values, but to the mechanical or even chemical features of the underlying rocks.

Many of the items which form the object of study in these preliminary examinations as to the feasibility of a project are of a nature such that the work on them should be continued indefinitely. For example, it is desirable in the preliminary work to ascertain the rainfall and evaporation at or near the reservoir site. These observations should be continued, even after the works are built, as they afford data needed in the proper operation of them. Also in connection with the behavior of water underground, the height of the water table, both in the irrigated and drained areas should be noted from season to season and arrangement made for systematically obtaining and recording these facts which show the changes which are taking place beneath the surface. Thus in planning the preliminary examinations, provision should be made for maintaining certain kinds of observations indefinitely.

### GENERAL PLANS.

The result of surveys and examinations are embodied in broadly developed plans, usually for consideration of various large alternatives. As a rule, there may be present two or even three or more ways of achieving results, these differing mainly in estimated cost. It is possible, for example, that one plan for a feasible enterprise may involve, for an irrigation work, the reclamation of, say, 10,000 acres at a cost of $50 per acre. A modification of this plan or alternative proposed may enable the bringing in of 12,000 acres at a cost of perhaps $52 per acre. The question then arises as to whether a somewhat larger cost per acre may be justified in view of the increased acreage which may be utilized. If the enterprise is purely a money-making proposition in which the promoters are concerned with getting back their investment at the earliest possible date, they may prefer the cheaper. On the other hand, if the money is furnished by the public or by semi-public institutions such as irrigation districts, the general benefit to the entire country may unquestionably justify the larger and more expensive undertaking.

Fundamental questions of this kind can be considered on their merits only when the larger plans have been developed to a point where it is possible to make direct comparison of costs and benefits. For this reason, as before stated, the surveys and examinations must not merely be thorough, but the plans based upon these must be sufficiently broad to permit a full grasp of the situation.

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### DETAILED PLANS.

The general plan finally agreed upon as to location and character of works must be supplemented by detailed drawings and specifications such as to enable experienced contractors to bid intelligently upon all of the items involved. It is characteristic of American enterprises, as distinguished from European, for the promotors to rush into construction long before the plans have been fully matured. There is an impatience for visible results on the part of the investors, whether individuals or the public, which will not brook delay. Wise managers have frequently yielded to these importunities even though they know the final outcome will be unnecessarily expensive. This is not wholly confined to America, as throughout all time has been repeated and attributed to popular heros, ancient and modern, the story of the foreman who built the bridge before the engineer's "picture" was ready. This is an amusing instance of efficiency in saving time in an emergency, but for a permanent work it probably means that future generations must pay several prices for the immediate saving thus made.

There is probably no one place where greater economy can be secured than in the repeated study and the drawing again and again of the plans until a high degree of perfection is reached in all essential details. It is, of course, easy to look back after a structure is completed and see how certain more or less important features could have been modified to advantage. In the case of well considered works, these savings detected after completion are usually small, but in many instances the responsible men in charge are too well aware that if they had been allowed proper time to plan out all details they would never have located the works at the place nor built them of the character as finally finished.

### CONSTRUCTION METHODS AND MATERIALS.

The methods of construction must, of course, be adapted not only to the material available, but to the peculiar conditions of labor which may prevail in the vicinity, and especially to the matter of transportation. As a rule irrigation or drainage works, especially the former, are built under pioneer conditions far in advance of actual settlement of the country and of construction of wagon roads or railroads. This is a condition which is not always appreciated by the man who may be inclined to criticize the works after they have been finished and in use. The construction methods which may be necessary at a point 50 miles from a railroad and at a locality to which access can be had only over rough mountain trails must necessarily be in striking contrast to those alongside of a through line of a railroad, one which may be built after the works are completed, and as a result of such works.

The materials to be used under such conditions are limited to the immediate vicinity. If plenty of rock is to be had, masonry may be the best. If the rock is poor, it may be possible to consider concrete, if the cost of bringing in cement is not prohibitive. Otherwise, earth, if available, must be used. This illustrates the point that the surveys and examinations which precede the preparation of any set of plans must be of such character as to answer these points when they come up for careful consideration.

*Construction contracts.*—Under modern methods of construction, the greater part of the work is executed under carefully drawn contracts, in which responsible builders agree to execute a certain described structure for a definite price per cubic yard or per item specified. In work of a character of which the nature is well known, or where the same operation is performed over and over again, it is possible for an experienced contractor to ascertain the cost in advance within narrow limits and to exercise his experience in handling men or mate-

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rials to secure greater economy, and consequent profits, than his competitor. In proportion, however, as the work is pioneer in character and involves unknown conditions, the preparation of a bid becomes more and more of the nature of gambling upon chances. Thus enters certain disagreeable or even disastrous conditions. There are always contractors more or less responsible who are willing to take their chances. Usually those men who know least about the probabilities of the case offer to do the work at a cost less than that given by the more experienced and safer men. If conditions turn out better than anticipated, they may make considerable sums of money. If, however, unusual storms occur or the rock is found to be of different character than anticipated, the contractor may fail, with consequent delay to the work and increased expense, both in litigation and in securing a new contractor.

It is to the advantage of all concerned to remove as far as possible the element of chance in construction work; in other words, to make the examinations as complete as possible. It may be advisable, for example, not merely to make a number of test pits in the soil and to put down drill holes, but also to lay out and build well-considered roads to reach the place of construction and to open up a considerable part of the foundations which are to be excavated so that the experienced contractor will be able to see from actual operation on the ground what are some of the difficulties to be met. In the meantime it is often necessary for the man in responsible charge to firmly reject offers for work which are made by men of relatively small experience or who propose to experiment with novel machinery or methods. While they may succeed, the probabilities against this are so great that it is not wise to incur the risk of failure and litigation.

In case of deep foundations, tunnels, and similar works, where it is almost impossible to explore all of the conditions, the investors may well consider doing the work at their own risk and under the direction of experienced engineers and superintendents. In such case, however, it is wise to follow the form of a contract, preparing the plans and specifications and designating one of the responsible employees to act in the capacity of contractor and to execute the work in a manner much as though he were building it under contract, having at the same time a suitable inspector to check up the work from day to day as if it were thus being executed. In this way the engineer or superintendent in direct charge of construction is interested to secure the economies such as those which might be had by a contractor, and while he is not as immediately interested financially in the profits or losses as a contractor, yet he is stimulated to make as good a showing as possible under the agreed terms. If ultimately it turns out that the work costs more than anticipated and the contractor would have lost, the investors are protected in that they are saved delay and law suits which would result, and the works will undoubtedly cost them no more. It is rare, indeed, that the loss to a contractor through underbidding results in gain to the investors. Such losses are usually more than balanced by the accompanying confusion and controversy.

### STANDARD PLANS.

For the execution of any large work of irrigation or drainage there are required plans of almost innumerable smaller structures. For example, in turning water to the irrigated farms there are required hundreds of small flumes or gates, many measuring devices, bridges, and culverts. Although at the present time the construction of such work has not advanced to a point where, as in railroad building, there are certain widely adopted sizes and shapes, yet it is practicable to adopt certain standards such as have been found advisable in similar work elsewhere. The Reclamation Service of the United States

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Government has led in devising standard plans, and although these are subject to modification from time to time, yet, as a whole, it is probable that these standards may be widely adopted to advantage. In any event, there should be determined upon at an early date a few fundamentals regarding the character of construction so that it will not be necessary to state each time the particular way in which every new structure should be built.

*General dimensions.*—The adoption of standard plans necessitates at the same time certain broad statements of the general sizes and dimensions, such as of the side slope of canals and drains, bottom widths and velocity for conduits of different kinds. All of these matters have been worked out for various existing projects built by private and public corporations. From the experience had with these it should be possible to select the dimensions which have been found most suitable or best adopted to the prevailing conditions as shown by the examinations made of the proposed project. For example, in the case of slopes the field studies having shown that the material to be excavated for a canal is relatively hard and not easily eroded, then it may be possible to introduce and use slopes higher than the average employed elsewhere, with corresponding economy in size of cross-section of the canal.

The most important matter, however, in considering general dimensions is that having to do with the future operation of the works. In many localities irrigation systems have been planned with the idea of dividing and subdividing water into smaller and smaller streams until each division is accurately proportioned to the needs of the farms to be served. This has been done under the assumption that the irrigators should have a certain steady flow of water from the main system. Later it was demonstrated that greater economy of time on the part of the irrigator, and of water, could be had by turning to him not a small stream, but one sufficiently large to irrigate his entire farm in a relatively few hours. Then it was apparent that certain structures and conduits must be enlarged to meet the new conditions. In this case, too, great care had been devoted to the exact proportion of details and not sufficient allowance made for changes which might take place. Thus at the outset the general dimensions of waterways must be set from a full consideration of the ultimate operating methods and costs.

## RESERVOIRS.

The earlier and smaller irrigation projects have depended almost wholly upon the unregulated supply of streams. They have been developed or enlarged to a point where they are taking all of the water which flows during the dry part of the year. The later and usually large projects, to be successful, must depend upon water which may be stored in suitable natural depressions or valleys with narrow outlets. There are relatively few localities easily adapted to this, and at the outset the question is raised as to how much money may be properly expended in building works for the storage of water for irrigation.

In the case of muncipal water supply, with dense population, it may be possible to expend sums of money, so large as to be practically prohibitive to an agricultural community. Such city storage works are illustrative of what may be done from the engineering standpoint, but they can not always be safely used as guides in agricultural development.

As suggestive of irrigation possibilities may be given the expenditures made by the United States Reclamation Service. The cost ranges from a minimum of 20 to 30 cents per acre-foot of water stored up to over $20 per acre-foot for certain reservoirs. In the case of the smaller cost, large natural lakes are utilized and storage capacity increased by relatively inexpensive dams and gates. The total capacity provided by the Reclamation Service from 1904 to

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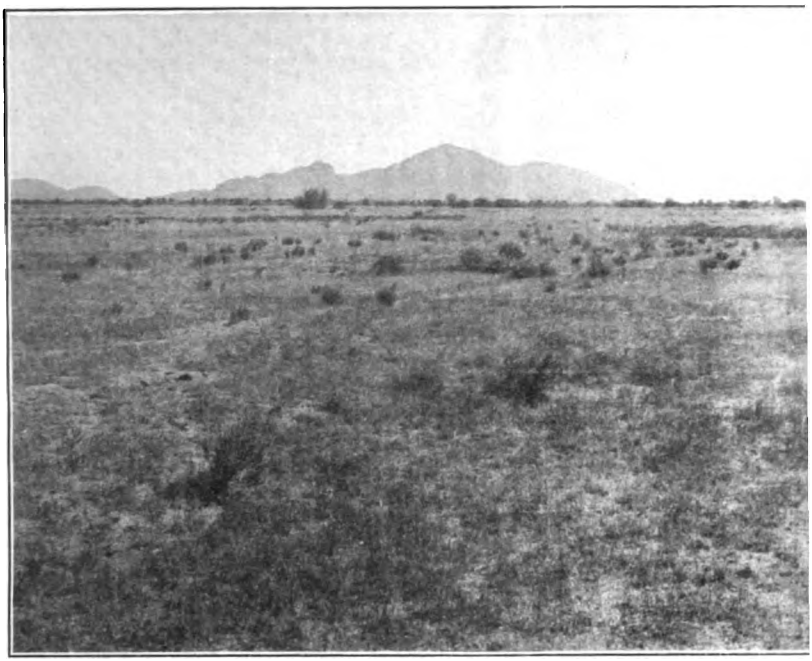

ARIZONA DESERT BEFORE RECLAMATION.

ARIZONA DESERT RECLAIMED.



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1914 aggregates in round numbers 9,000,000 acre-feet at a cost of about $3.50 per acre-foot. The following table, prepared by Chief Engineer Arthur P. Davis, gives the principal features of these reservoirs:

*Estimated capacity, duty, and cost of reservoirs.*

| Name. | Capacity (acre-feet). | Duty (acre-feet).[1] | Estimated cost. | | |
|---|---|---|---|---|---|
| | | | Total. | Per acre-foot. | |
| | | | | Capacity. | Duty. |
| Arizona: Roosevelt | 1,365,000 | 500,000 | $3,883,000 | $2.84 | $7.76 |
| California: | | | | | |
| East Park | 51,000 | 30,000 | 287,000 | 5.64 | 9.58 |
| Feed canal | ..... | ..... | 160,000 | ..... | ..... |
| Idaho: | | | | | |
| Arrowrock | 250,000 | 200,000 | 4,772,000 | 19.10 | 23.86 |
| Deer Flat | 177,660 | 177,660 | 1,048,000 | 5.90 | 5.90 |
| Lake Walcott | 150,000 | 53,000 | 690,000 | 4.60 | 13.00 |
| Idaho-Wyoming: Jackson Lake | 789,000 | 700,000 | 1,253,000 | 1.59 | 1.79 |
| Montana: | | | | | |
| Sherburne Lakes | 78,000 | 78,000 | 513,000 | 6.84 | 6.84 |
| Nelson | [2] 27,000 | [2] 27,000 | 46,000 | 1.70 | 1.70 |
| Willow Creek | [2] 16,700 | [2] 16,700 | 270,000 | 16.20 | 16.20 |
| Nebraska-Wyoming: | | | | | |
| Pathfinder | 1,070,000 | 500,000 | 1,827,000 | 1.71 | 3.66 |
| Lake Alice | 11,400 | 11,400 | 218,000 | 19.10 | 19.10 |
| Lake Minitare | 67,025 | 67,025 | 564,000 | 8.42 | 8.42 |
| Nevada: | | | | | |
| Lake Tahoe | 120,000 | 120,000 | 160,060 | 1.33 | 1.33 |
| Lahontan | 290,000 | 290,000 | 1,580,000 | 5.28 | 5.28 |
| New Mexico: McMillan | 70,000 | 40,000 | 143,000 | 2.05 | 3.58 |
| New Mexico-Texas: Elephant Butte | 2,368,600 | 720,000 | 4,866,000 | 2.05 | 6.76 |
| Oregon: | | | | | |
| Cold Springs | 50,000 | 40,000 | 446,000 | 8.92 | 11.15 |
| Feed canal | ..... | ..... | 330,000 | 6.60 | 8.25 |
| Oregon-California: Clear Lake | 462,000 | 10,000 | 138,000 | .30 | 13.80 |
| South Dakota: | | | | | |
| Belle Fourche | 203,000 | 203,000 | 1,237,000 | 6.10 | 6.10 |
| Feed canal | ..... | ..... | 332,000 | ..... | ..... |
| Utah: | | | | | |
| Strawberry | 250,000 | 100,000 | 612,000 | 2.45 | 6.12 |
| Tunnel | ..... | ..... | 1,200,000 | ..... | ..... |
| Washington: | | | | | |
| Salmon Lake | 2,600 | 2,600 | 12,000 | 4.75 | 4.75 |
| Conconully | 13,000 | 10,000 | 341,000 | 26.20 | 34.10 |
| Bumping Lake | 34,000 | 34,000 | 555,000 | 16.30 | 16.30 |
| Lake Kachess | 210,000 | 180,000 | 840,000 | 4.00 | 4.65 |
| Lake Keechelus | 152,000 | 152,000 | 1,397,000 | 9.20 | 9.20 |
| Wyoming: | | | | | |
| Shoshone | 470,000 | 470,000 | 1,350,000 | 2.87 | 2.87 |
| Ralston | 2,100 | 2,100 | 17,000 | 8.10 | 8.10 |
| Totals and averages | 8,749,485 | 4,734,485 | 31,087,000 | 3.50 | 6.50 |

[1] Estimated average annual draft of *stored* water. [2] Partial development.

DAMS.

The surveys and examinations of any proposed irrigation enterprise and of the catchment area tributary to it will usually reveal the existence of suitable basins or depressions which may be converted into reservoirs. They should show also the character of material available for construction and the foundations upon which each proposed structure must be built. Having obtained these essential data, the next question for the consideration of the engineer and of the investor is as to the relative costs and permanence of the structures which may be needed for creating the necessary water storage.

Even after a suitable location has been found for a reservoir it is usually necessary to examine a number of alternative locations for the site of the dam. Sometimes there must be provided not only the principal dam at the main out-

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let of the valley or depression, but also a number of supplemental dams or dikes to raise the rim of the basin at various points. Even if there is only one gorge or narrow outlet where apparently the dam can be located, yet there are usually many alternative points a short distance apart where the underground conditions may differ and where one may be better than any of the others, although all look about alike. This fact can be determined only by careful exploration, usually by digging test pits or putting down drill holes. Even with all ordinary care it may result that when the foundations are finally opened conditions may be discovered which will force a relocation higher up or lower down in the gorge.

*Masonry or concrete dams.*—If the foundations are found to consist of solid rock and there is ample similar good material in the vicinity, the structure may be designed to be built of ashlar or rubble masonry throughout. Usually, however, it is desirable to consider the practicability of building the works of concrete. With the recent developments in methods in the manufacture and use of cement, it frequently occurs that economy in construction can be secured by crushing the rock which formerly would have been used in ordinary masonry and then making a relatively homogeneous mixture of concrete instead of attempting to quarry large blocks and lay each of these separately in a bed of mortar.

The question may also be considered for each locality as to whether it is preferable to attempt to place in the concrete large dimension stones or pieces weighing several tons, or, on the other hand, to reduce all of the stone to small pieces, fairly uniform in size, and to handle these systematically by modern high-power and high-speed machinery. The present tendency is toward a systematic organization of machinery and men, such that one simple procedure is followed day and night, continuously for months, from the time the structure is started until it is finished. It has been found that although, theoretically, at least, there might be an advantage in using large stones, bedding these in the body of the dam, yet, as a matter of fact, the time spent in quarrying and conveying these, and particularly in setting or bedding them in place, interferes with the otherwise orderly procedure, so that in the long run the gain from their use is not as great a source of economy as was anticipated, nor is it apparent that the strength of the structure is increased.

In most instances the materials in the quarry available for building the dam are of such character that the obtaining of large solid blocks is a matter of considerable expense, necessitating much stripping and waste of material. Usually the rock is divided by seams or planes of weakness, which interfere with obtaining solid blocks of fairly uniform size and shape. If, however, the attempt to secure such large blocks is abandoned and the firm material from the quarry, irrespective of size, is broken up, run through a suitable crusher, and selection made automatically by screens and otherwise of suitable small pieces, the proportion of available material is greatly increased; there is less waste in the quarry and in the subsequent handling, and, more than this, the machinery can be operated at a relatively steady rate and without the delays incident to handling single large quarry stones. Thus, with the development of machinery and effective methods of organizing equipment, not only is the use of ashlar or rubble masonry declining rapidly even in massive structures, but also the use of large blocks or "plums" in concrete is decreasing in favor of the more uniform mixtures.

As yet no limit has been set to the size and height of structures which may be built of masonry, and particularly of concrete. The highest dam in the world, so far as known, is that built by the Reclamation Service on Boise River in southern Idaho, known as the Arrowrock Dam, 350 feet in height

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and 1,075 feet long on top. This is a curved structure, of gravity section, containing 530,000 cubic yards of rubble concrete, built with expansion joints and with inspection galleries running through it in such a way as to permit continuous observation of the behavior of the dam, the temperature changes, and the percolation which may take place.

There is nothing, as yet developed, which would indicate that the limit in height has been reached, or that it is not practicable, by increasing the dimensions, to build structures of even greater height. Theoretically there may be a point where the hydrostatic pressure on the foundations will severely test the porosity of some of the materials employed, but it is proper to assume that such limitations have not yet been reached, and that by proportioning the structures such that the pressure on base will not be excessive, provisions may be made for still greater heights. In all cases there must be care exercised in securing proper drainage of the foundations and of the dam itself, so that any water which may penetrate the foundations or into the body of the dam can freely escape and without accumulation of upward pressure which may tend to lift the structure.

*Loose-rock dams.*—There are conditions where on account of imperfections in the foundations it is not practicable to build the ordinary concrete or masonry structure but where it may be possible to erect a dam of relatively low height and of materials not carefully fitted or cemented together, but where each individual rock is held in position by a more or less loose contact with its neighbor. A loose-rock dam of this character, built of stones as large as can be handled, is in effect a barrier which withstands the pressure or attack of the water by its own mass or weight. The body of a dam thus composed of big and little pieces of rock is, of course, permeable to water; for effectiveness it must be provided on the upper side with a water-tight diaphragm or apron.

To put it in another way, a loose-rock dam consists of a relatively thin water-tight wall or layer of steel, wood, or clay held in place by a heavy mass of pervious material. In constructing such a dam, the larger blocks are thrown or dropped into the stream or depression to be closed. As a rule the water flowing through or over these rearranges and compacts them to a certain extent. On the upper face smaller and smaller stones, gravel, and sand are applied in succession, gradually reducing the size of interstices and finally on the upper water face is put a layer of clay of such fineness that the water can not penetrate. In some cases where the dam can be built in the dry, the impervious layer consists of a plank or steel or iron covering suitably held in place. Such loose-rock dams, if carefully built and maintained, may serve indefinitely and at a cost—when interest on the investment is considered—far less than that of the more substantial masonry structure. There is, however, always the element of doubt as to what may happen, especially in those portions which can not be inspected.

*Earth dams.*—At the outlet of many possible reservoirs there are to be found no solid foundations nor rock of sufficient hardness to build either a masonry, concrete, or loose-rock dam. The cost of bringing stone from a distance is prohibitory. Under these conditions it is necessary to consider whether a structure may be built of the earth which occurs in the locality. Here is involved a question of the selection of suitable material near the dam site and of handling it in a systematic fashion, depositing it in place with great care and uniformity such as to secure practically water-tight conditions. An earth dam is similar in some respects to a loose-rock dam in that the upper or water face should be made as nearly impervious as possible, while the down-stream or

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dry portions may be built of coarser material and should be drained to permit the escape of any water which may penetrate relatively impervious layers. While it may be practicable to permit water to overflow a masonry, concrete, or loose-rock structure, such action means destruction to an earth dam, and hence every effort must be considered in preventing water from flowing over the top of a structure of this kind.

Usually in building an earth dam it is not practicable to carry the foundation down to bedrock, as is necessary in the case of masonry structures. In all cases, however, the ground must be stripped to an impervious layer of clay or "hardpan," and the materials composing the dam placed on these and carefully incorporated with the new surface thus exposed. The carefully selected earth to be used in the body of the dam should be slightly wet and rolled in thin layers to secure the highest degree of compactness. Layer after layer of 3 or 4 to 6 inches in thickness are thus worked into place, care being continually exercised to secure the thorough compacting, no details being slighted or omitted. The results are tested from time to time to see that the body of the dam is homogeneous and does not contain any defined layers or incipient cracks into which water may enter.

In cross section the earth dams are in striking contrast with those built of masonry or concrete in that the slopes must necessarily be well within what is known as the angle of repose. On the upstream face these slopes are usually 1 foot or meter vertical to 3 horizontal, and on the downstream or dry side 1 vertical to 2½ horizontal.

The upstream or water side of any earth dam must be protected from wave washing by some relatively hard material, such as a heavy paving of rock 2 or 3 feet in thickness, or by concrete blocks 6 inches or more in thickness, held in place against disturbance by storms. In some cases a thick layer of heavy gravel has been applied, as, for example, on the earthen banks of Deer Flat Reservoir in southern Idaho. The waves are allowed to carve this gravel bank into relatively stable slopes. The downstream side of the earthen dams must also be protected, usually by encouraging the growth of vegetation and by preventing the washing of rain water by providing suitable gutters or drains to keep the water from gulleying the surface.

*Spillways.*—In making plans for any dam, whether masonry or earth, there must be ample provision for spillways for passing excess water of unusual floods. In the case of solid masonry or concrete dams of moderate height the entire crest may be made into a spillway, but as a rule it is wiser to provide a depression or low point of overflow some little distance from the dam, so that the water of great floods may not attack the foundations and wear away the supporting walls. As above noted, it is absolutely essential that in the case of earthen structures the spillway be of such size and shape as to render it impossible for water ever to overflow the earthen banks; the margin of safety against overtopping by any probable flood must be large. We are constantly learning that even with fairly long-continued observations of river flow there are apt to occur extraordinary floods surpassing those of previous years, and that in these matters we can not afford to take any chances, but rather to provide maximum flood openings.

*Gates.*—In connection with every reservoir or dam for holding water provision must be made for regulating the outflow so that the stored water may be available when needed. The character and position of the outlet is determined largely by the foundations of the dam. As far as practicable the outlet and gates should be built independent of the dam and located in solid rock so as not to introduce points of weakness in the dam itself. The ideal condition is to place the gates on solid rock at one side of the dam.

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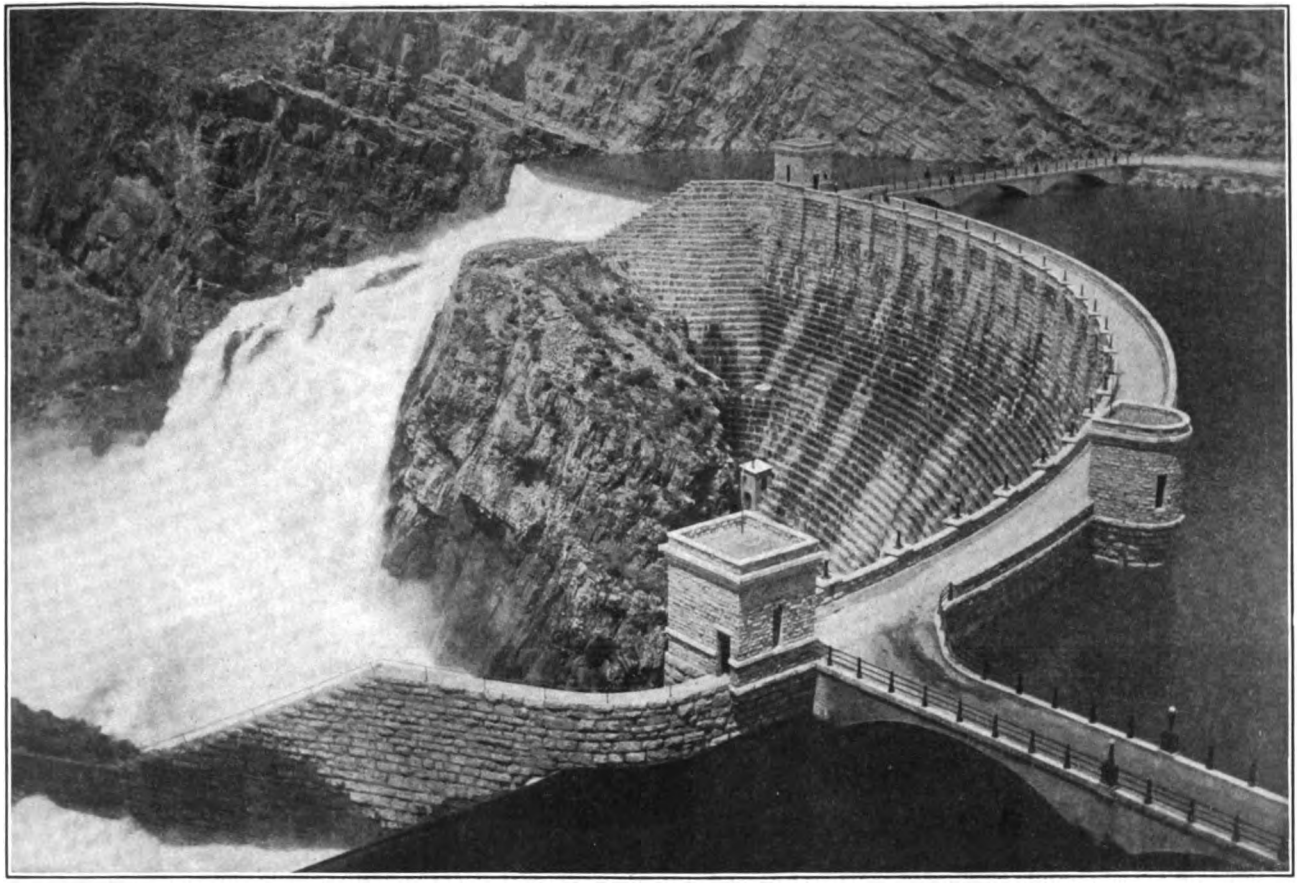

ROOSEVELT DAM WITH FULL RESERVOIR AND WATER PASSING OVER SPILLWAYS.

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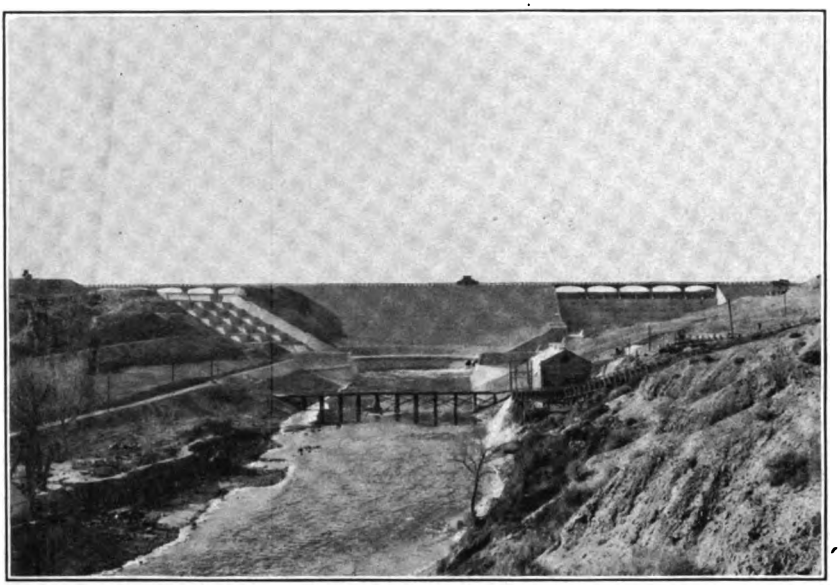
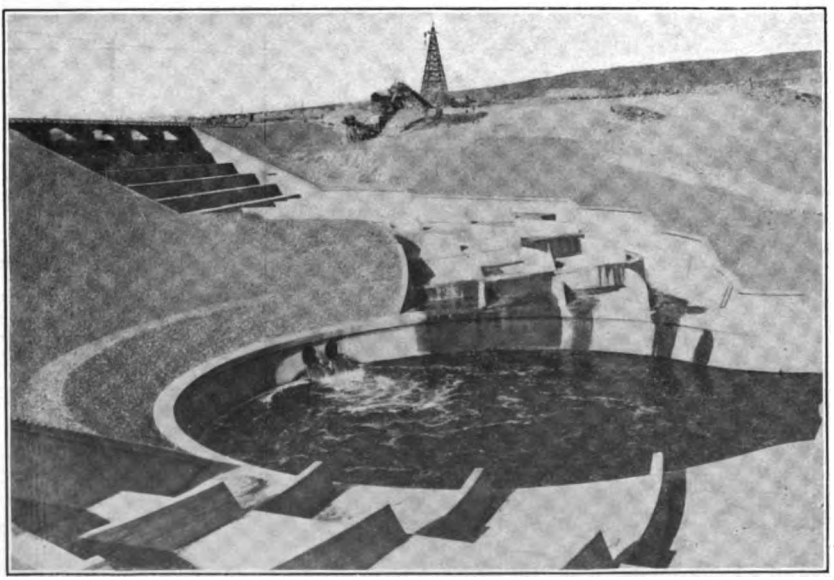


LAHONTAN DAM, TRUCKEE-CARSON PROJECT, NEVADA.



**STEPPED SPILLWAY CHANNELS AND POOL AT BASE OF LAHONTAN DAM, NEVADA.**

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Occasionally, however, it is necessary to build these through or in the body of the dam, and in such case extraordinary care must be used to see that water is not permitted to enter the body of the dam or percolate along the outlet works.

The types of gates ordinarily employed are vertically sliding valves, usually rectangular and carried on friction rollers. For smaller outlets the circular valves, such as are used on city waterwork pipes, are employed, and for low heads or emergency outlets occasionally the hinged butterfly type is used.

It has been found that the larger valves or gates leading from the reservoir should be operated if possible in such way as to avoid opening them when under a pressure or head of 100 feet or more. While it is possible to open or close them under these high heads, the erosive action of the sediment bearing waters and the vibrations set up introduce so many complications or dangers that with deep reservoirs it is safer to provide methods of letting out water at successive elevations, gradually drawing it down through successively lower outlets and using the lowest outlet only when the water level has sunk below the other gates.

*Diversion dams.*—After water has been held or controlled in storage reservoirs it is turned out when needed and passes down usually in the channel of the natural stream. From some convenient point along the stream the stored water or the ordinary flow is taken into the irrigating system usually by means of a so-called diversion dam which checking the flow of the river forces it into the head of the main canal.

Diversion dams differ from storage dams in that they are relatively low and are located in or across the main drainage lines being thus subject usually to overflow. As a rule there is accumulated against them the débris carried by the river and the pond or storage originally created by building the dam is destroyed in a few years by this accumulation. The original or simplest type of diversion dam consists merely of large stones placed across a river or diagonally up stream into the current. In times of low water a relatively tight barrier is being thus built of stones and dirt with brush or boughs of trees. With the development of the country and necessity for more permanent structures, low solid masonry dams or sills have been built or walls of concrete—these in turn being replaced by more carefully designed overflow dams, raising the water to still greater height and permitting the construction of higher canals.

*Carrying system.*—Starting out from the diversion dam is the main canal with its control gates and spillways. It usually winds along nearly parallel to the river until, with less grade than the river, it has succeeded in reaching an altitude where it can swing back from the stream. Sometimes two main canals are thus built one on each side of the stream. These may continue for many miles before reaching any considerable area of agricultural land. There they usually divide or branch to reach the principal body of the land. The number of miles of main and branch canals traversed by the water before reaching the irrigable lands varies greatly with the different systems. For the purpose of comparison, therefore, it has been found desirable to distinguish this part of the irrigation system, beginning at the diversion dam and extending down and including the main and principal branches as the carrying system. It is composed of relatively large canals, deep and narrow when in solid rock or side hills, and broad and shallow when out in the open plains and built in ordinary earth. The cross section thus varies from place to place dependent upon the ground in which the canal is built and upon the slope which may be given. Usually there is need of keeping up the canal as high as

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possible, reducing the fall per mile to the minimum of a foot or less thus necessitating a large cross section. Occasionally, however, especially where the canal first leaves the river, the conditions may be such that greater slope can be given and the cross section reduced or in some cases lined with concrete to produce the greatest velocity and quantity of discharge in the smallest amount of excavation.

*Distributing system.*—An irrigation project may be so fortunate as not to need any storage works and the topography of the country may be such that its carrying system is insignificant, but in all cases the distribution is a vital point. While apparently simple, in that it consists of miles of smaller canals and ditches located according to the slope of the country, yet in practical operation the distributing system involves more detailed problems in proportion to the cost than do the storage or carriage of water. It is usual for the highest engineering skill to be employed in the planning and building of a great dam or large canal. Unfortunately the same degree of skill has rarely been employed in laying out the distribution system. Hence it has come about that in the actual operation an unnecessarily large number of difficulties and sources of expense have frequently arisen more than should have occurred had the system been laid out by men thoroughly acquainted with the problems of handling the water to the farms.

The condition is similar to that in railroad location where the early railroads were built mainly with reference to construction cost. Now with larger experience the ease or economy of construction are kept secondary to the requirements of operating, since these go on forever, while the construction costs are only for a short period.

The distributing system consists of the so-called laterals or smaller canals taken from the side of the main or branch canals. The distinction is purely arbitrary and yet is one of importance. The laterals should be planned and built not only to command the largest possible area, but to permit the most economical handling of the water to the farms. If too small it is not possible to serve the lands rapidly, and if too large the channels become choked with weeds or mud and introduce unnecessary cost in cleaning.

If the land to be served consists of uniformly sloping plains, the laying out of the system is relatively simple. It is then a matter of determining the amount of water which should be carried at various times in the different ditches and in proportioning these of a size such that under a good system of rotation the maximum head can be delivered for the irrigation of the given area. As a rule, in the past too little attention has been paid to this matter, and in the operation of the lateral system it has not been found possible to rotate in the delivery of water to any one tract a large enough flow to secure the quickest and most economic use of water.

If the country is undulating, the laying out of the system becomes more difficult since the laterals must be located on the ridges and in such a way as to effectively command the irrigable lands. It is not possible to proportion the size as accurately as can be done when the slope is practically uniform.

The greatest difficulty, however, occurs when the area is undulating and there are low hills or spurs of agricultural land whose summits can not be reached by following around on some leading ridge. Here it is obvious that water must be conducted across the depressions by elevated flumes or by pressure pipes. Much care and thought must be given to the various alternatives and especially to the probable cost of maintenance of the structures. Usually these are built of wood and as the country develops they may be replaced by more permanent earthen fills or by buried pressure pipes.

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In all cases the attempt is made to bring water to the highest point on each farm where it can be delivered to the farmer through suitably constructed gates and measured usually over a simple weir.

*Measurement of water.*—In the older and smaller systems where the manager has grown up with the work it is possible for some one man or group of men to carry in mind all of the details and to apportion the water fairly well to the relatively few water users; but in the modern, large system built to supply water to hundreds of farms this easy-going way is not longer applicable. The condition may be compared to that of the country merchant who knowing his people can apportion among his customers a pile of coal or of wood roughly by his eye and with reasonable satisfaction. When, however, he must delegate these details to others and he can no longer know of each transaction, to avoid difficulty and bankruptcy, he must maintain a thorough system of weights and measures and make record of each transaction.

So it is with the measurement of irrigation water. The older managers naturally resented the introduction of troublesome details of measurement and asserted that for all practical purposes their methods are best. A study of these, however, shows that there has been great inequality in irrigating streams supposed to be of the same volume and enormous waste of water, resulting in ruin to large areas of land. The only way in which such injurious conditions can be prevented is to keep a record of the water available in the storage reservoir, also the quantity received in the main canal and divided to the principal branches and more than this the time and amount of water turned to each farmer. Having these details it is possible day by day to ascertain where the water goes, the quantity of waste, and to check up against the acreage the beneficial use of the water. When once a proper system has been installed, the advantages as compared with the costs are so great that no one seriously advocates a return to the old haphazard method.

*Heads of water.*—The amount of water which any one man can economically apply to his fields varies according to the skill of the farmer, the soil, the crops, and especially to the care with which the surface has been leveled. The tendency has been to progress from the use of relatively small streams or heads of 1 cubic foot per second up to three or four times this amount or even to 10 or more second-feet, an amount which the older irrigators would regard as absolutely impossible of control.

With larger heads there results quicker irrigation and the application of a proportionally less amount of water for the area to be covered; also larger crop yields per unit of water applied. This fact is often doubted, but careful observation shows that with proper preparation of the ground and skillful handling, the larger irrigation heads are more economical of time and water than the smaller.

*Rotation of flow.*—In the pioneer days of irrigation in the United States it was customary for the farmers to receive a small steady flow of water, one which could be turned to a field, the gate set, and the farmer go about his business, or at night go to bed and in the morning see what had happened. If everything had continued as anticipated, the water in time would reach the end of the field, and while the upper portions were overirrigated, the lower part would have a small supply. Often, however, especially during the night, the stream became obstructed or a wind storm diverted it. As a result there would be a pond in one place and dry spots in another. With the increasing need for more water for additional lands and demand for economy, came about a realization of the fact that a larger area could be irrigated by using the water more carefully, especially by giving personal attention to the flow

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and utilizing larger streams for shorter times. There thus arose the custom of two or three neighbors combining in one head or stream the quantity of water to which each was entitled and using this in succession, shutting off the flow when not needed and turning the supply over to another neighbor, and so on, applying the water at intervals of a few days and doing all of the watering of one field in a few hours.

One of the disadvantages of this rotation is that the water must be taken and used irrespective of the time of day or night, and if an irrigator's turn comes in the evening it may be necessary for him to work most of the night by the light of a lantern to get water over the field. Some, skilled in details, prefer the night irrigation, as they think that the water goes farther and better. With everything prepared they can work through the cool night with greater comfort. Others naturally object, and the introduction of rotation in countries where there has been a steady flow is strenuously opposed until the majority are convinced of the economy and efficiency of this method.

### DUTY OF WATER.

The expression "duty of water" is usually applied to the area which may be irrigated by a given quantity of water. We say that the duty of water is low when only a small area of land is irrigated by a considerable stream; for example, if 1 cubic foot per second is used on 70 acres. It is high if this quantity irrigates 160 acres, or more. When we consider water, not as flowing in a stream but as held in a reservoir, we speak of a low duty of water in that 3 acre-feet of water had been applied during an irrigation season to a single acre, or, in other words, if an acre has received an aggregate depth of 3 feet. The duty was high if the acre was satisfactorily irrigated by the application of a quantity of water which would have amounted to 1.5 feet in depth, or 1½ acre-feet.

The theoretical duty of water is far higher than that actually obtained. There is need for the production of a pound of dry matter, for forage or other crops, from 300 to 1,000 pounds of water. This would mean a few inches in depth over the entire surface. To bring these few inches to the plant, however, requires the use of several times this amount of water in transporting the necessary quantity, because of the loss in transit by seepage into the soil, by evaporation, and in other ways. As a matter of fact the duty of water as measured in common use may be extremely low. Men have applied as high as 5, 6, or even 10 feet in depth on sandy soils and yet have complained of not having enough. Others assert that they have raised good crops on an aggregate of 1 foot of water in depth during the crop season.

The old rough and ready rule was an inch to the acre, meaning a miner's inch or the one-fortieth or one-fiftieth part of a cubic foot per second. Later an inch to 2 acres became the more common expression, meaning that a cubic foot per second or 40 or 50 miner's inches flowing through the irrigation season of, say, four months or 120 days, would irrigate 80 to 100 acres, giving an aggregate depth of 2.4 feet to 3 feet.

### OWNERSHIP OF WATER.

In discussions of the duty of water and of the economy of use, it is important to consider the legal or ethical relations involving responsibility for securing the largest possible use of water. Throughout the arid region, as a rule, there is more land than water. In other words, the extent to which the dry but otherwise productive land can be put to use is governed by the care and skill employed in conserving and utilizing the limited amount of

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water available. The question may thus be asked as to the duties of citizenship with respect to economy of water. Is it a substance whose full ownership may be acquired by an individual and used or wasted according to the desires of that particular person? If each man is at liberty to acquire and hold for his own enjoyment any considerable amount of water in the arid region he may be able, theoretically at least, to prevent the development of the country and keep away from the land a population which otherwise would find prosperous homes and farms. It is generally recognized that the owner of a tract of land may do what he pleases with it, letting it be idle indefinitely if it so pleases him. Is water a species of property in the same sense that is land, and can it be held out of use or wasted?

In the case of waters which are abstracted from flowing streams and held in a barrel, tank, or artificial reservoir it is usually conceded that the man who thus obtains possession of this definite, limited quantity is the owner and may dispose of the water as he would of other merchandise, but in the case of flowing streams the contents are different. The stream itself may remain in a definite position throughout all times, but the component parts, the individual particles of water coming from the rainfall on the high lands, are continually being renewed—flowing down the slopes they disappear into the lakes or ocean or go back into the atmosphere. Under these conditions there have arisen at least two theories concerning ownership of the flowing waters. These owe their difference to the radical contrasting conditions in the country in which the legal theories arose.

In humid England and in the nearly equally humid parts of eastern United States water is usually in excess, and its intrinsic value is thus little appreciated. It may be regarded more as a nuisance than an essential element of life. The man who acquired title to a piece of land bordering upon a stream or through which a stream flowed came to be recognized as having a certain right to the use of the waters of the stream. His land ownership was usually bounded by the center of the stream or its deepest flowing channel. By the purchase of the land he acquired the right to use the water and to enjoy certain privileges, these being limited by equivalent rights of the landowners above and below him on the stream. There thus grew up the conception that the riparian owner could utilize the water so long as he did not interfere with the quantity and with the quality of the water which passed beyond his land to that of other riparian proprietors.

In the case of larger rivers or lakes the ownership of land covered by water was considered as being in the State, and the riparian ownership extended to high-water or low-water mark, but with certain privileges adherent in the fact that the land was bounded by the water surface. The principal cause of controversy under these conditions would be those arising from attempts to develop water power and to build dams flooding back upon the lands farther upstream. In these cases the matter was usually left to private arrangements, although in some States flowage rights might be acquired by legal processes.

In the Mediterranean countries of Europe and in the arid West where, with scarcity of water, most lands and industries, as well as life itself, is intimately connected with the water supply, it is obvious that a different rule must be enforced. The very existence of agriculture depends upon taking away from the streams an ample supply for the production of crops. In the aggregate this removal of water means the complete drying up of the streams and deprivation of lower riparian owners of its use. Obviously it is impossible for each riparian owner to enjoy the use of the water and at the same time permit it



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to flow undiminished in quantity and unchanged in quality. Hence has grown up what is commonly called the doctrine of appropriation. Riparian rights, as far as the arid States are concerned, have usually been declared to be nonexistent. The men who first took water from a flowing stream and applied it to beneficial use are thereafter protected in such use in the order of their dates of appropriation and use or of so-called priority, and to the amount which actually is utilized.

The ownership of the water in the arid region has usually been declared to be in the people, or in some instances in the State. The right to use, as distinguished from ownership, is vested in the various claimants in the sequence in which they first applied this water to beneficial use. Each of the Western States has adopted various modifications of these fundamental ideas. In the case of California, there is still some doubt as to the theory which will ultimately be upheld. In this large State, embracing both humid and arid areas, there grew up contradictory conceptions. In the northern part the judges, coming from the humid east, naturally inclined toward the riparian theory as the best solution of the controversies which arose. In the mining districts where the water was diverted for hydraulic mining and in the dryer parts of the State first settled by Spanish-speaking people, the doctrine of appropriation was so obviously necessary that no one apparently questioned its proper application. With the rapid development of the State and the overlapping of various interests there has come more or less of a clash of these conflicting ideas. Decisions have been rendered looking first in one direction and then in another according as the facts of each case have been presented. In some cases an apparent compromise has been attempted by recognizing but limiting riparian rights. The appropriators may proceed at their own risk in utilizing flowing waters, taking it out on riparian lands with the likelihood that lower riparian owners may at any subsequent time also divert water upon their riparian lands and compel others to divide water with them without respect to priority. Under this assumption, the vital point is as to what may be a riparian tract. Is it the smallest legal subdivision or 40 acres adjacent to a stream, or is it the whole extent, for example, of a Spanish land grant which may touch the stream and extend away from it for many miles?

Many volumes have been written upon this subject of ownership of water, and yet more may be prepared without exhausting the subject. For the present it is sufficient to call attention to these two apparently antagonistic views and to the uncertainties which prevail in many parts of the country because of lack of agreement on fundamentals. It is claimed that more money is being and has been expended in some of the Western States in litigation over the right to the use of water than in the building of the necessary works. There is no one matter more essential in the complete development of the resources of an arid region than the firm establishment of principles regarding the use of waters and recognition of the fact that this use must be safeguarded in the interest of the people.

Whatever the present condition of laws and decisions may be, there is no doubt as to the fact that in arid regions flowing water must belong to the people or to the State and that its use must be safeguarded to secure the highest benefit to the public. A further step in progress is being made in that beyond beneficial use there is coming to be a recognition of the need of economic use. It is not enough that water should be used beneficially; a moral if not a legal obligation exists that the water, the property of all of the people should be employed not merely to produce some crops but the largest and best crops. It is conceivable that a given quantity of water will produce 60 bushels

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of grain on an acre, and that the same quantity applied more skillfully to two acres would produce 100 bushels. The question is pertinent therefore as to whether it may not be the duty of the State to bring about conditions, as far as possible, under which more economical results will come from the use of a given quantity of water, even though beneficially used.

There is already recognized to be various degrees or stages of such beneficial use. In many States domestic and municipal supply come first and in case of need, the lesser uses must give way. Next in importance comes the production of food through irrigation, and, third, the use of water in power or manufacturing. In any controversy which may arise over a scarcity, the protection of life itself in domestic and municipal supply must be given precedence, then production of food through irrigation and last the profitable industries growing out of other uses of water.

### POWER DEVELOPMENT.

In connection with the works built for the irrigation of arid lands it is frequently found by the engineer that power may be developed, particularly at storage dams. There are also points near the head or along the line of the principal canals where water of necessity must descend to lower levels and where power may be had. As a rule, however, the best and largest use of the water for power is not consistent with its economical employment in irrigation. Power for most purposes, such as in manufacturing or in electrical lighting and transportation, must be practically continuous or at least available at regular intervals throughout the year. Irrigation water, on the other hand, should be applied only during a limited portion of the year, and at other times the surplus water should be accumulated in reservoirs or the canals should be allowed to become dry. There are occasionally conditions where power during the irrigation season has particular value and may be used to advantage, either in supplementing the water supply obtained in other ways or used in pumping or draining lower lands. Where pumping for irrigation is possible, there is usually a coincidence of such need with the time when water is turned out of a reservoir for irrigation purposes.

There are also instances where storage reservoirs are built on streams, the total flow of which is not available for storage. For example, it may be necessary to pass through a reservoir a certain minimum flow for the satisfaction of vested rights farther down the stream. The building of the dam and the permanent maintenance of high-water level in the reservoir enables the creation of a steady power because of the fact, above stated, that a certain quantity of water must continuously flow through or around the dam. Such, for example, is the case on the Snake River in southern Idaho, where at Minidoka Dam a certain low-water supply must be permitted to continue downstream to supply prior claimants. Here water power has been developed and power is had throughout the year, irrespective of the demands for irrigation.

The financial success for any irrigation project or drainage scheme and its adoption may be dependent to a large degree upon the complete development of all of these possibilities of power and related commercial enterprises. Hence it is incumbent upon the engineer in laying out any system for the development of the country to consider whether by modifications of his original plans it will not be possible to provide for power development and use. In connection with construction also there are always questions of cheap power, and cases have arisen where the cost of construction has been greatly reduced by modifying the original plans in such a way as to build the power plants first and thus utilize these in connection with the larger construction work. For example,

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in building Roosevelt Dam, in Arizona, the fuel cost was a large item. Many of the difficulties were solved by first building a power canal and temporary power plant, the canal being located around the upper edge of the proposed reservoir and the power plant immediately below the dam which was to be erected.

### USES OF POWER.

The problem of uses of power in connection with the building of irrigation works is usually presented in reverse order from that in other localities. Throughout the greater part of the country the question presented to the engineer is how to procure power for a certain definite need. In the undeveloped arid region, however, where irrigation must precede settlement, cultivation, and the building of railroad lines, there is presented the fact that power may be developed at reasonable cost, but the engineer is confronted with the problem as to what to do with the excess beyond that needed for immediate construction purposes or for summer pumping for irrigation or drainage.

One of the large outlets suggested for the use of excess power is the fixing of nitrogen from the air and the manufacture of fertilizers so greatly needed in the new country. For example, a power plant, such as that built at Minidoka on Snake River, is put to its largest use only during three or four months of the extremely hot weather. The plant to be kept in the best condition for the time of maximum demand should be operated continuously. It is obviously impracticable to shut down, disband the operating force, and then in the summer get back the skilled men and run the machinery at high speed. How, then, can the skilled force be kept busy throughout the year? The solution, above indicated, of chemical industry which can be carried on throughout the year or at intervals between the irrigation seasons is one peculiarly attractive. In the case above mentioned, however, it has been found practicable to develop a winter load by selling the power at low rates to the small communities, not merely for lighting, which would require only a small fraction of the power, but for heating the houses, schools, and other buildings, and for domestic uses, including cooking. The comfort of the community has thus been greatly increased and it has been practicable to create a market in a pioneer agricultural area. There is, however, the demand for fertilizers and it is probable that in similar localities, with the development of experience along these lines, it will be practicable to bring about the manufacture of chemicals needed by the farmers or by local industries.

### PUMPING.

From what has been stated it is obvious that pumping water, particularly for irrigation, is one of the economies made possible by power development. Pumping has been resorted to in localities where it has not been practicable to bring water to the surface of the land by gravity; notably on the shores of lakes or in areas underlaid with water at moderate depths. The cost of pumping, however, has far exceeded the anticipations of its more enthusiastic advocates. Roughly stated, the cost of lifting 1 acre-foot of water 1 foot in height by ordinary small engines is about 7 cents; or to lift the water 50 feet would require $3.50 for irrigating an acre to a depth of 1 foot. This is at least three or four times the cost of gravity supply. In the case of orchards producing high-priced fruits it is possible to pump water profitably or even to elevate it for alfalfa lands with a lift of from 20 to 40 feet and upward. In the case of more valuable crops, such as cane sugar in the Hawaiian Islands, water has actually been raised to a height of over 500 feet.

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With large economical pumping plants the cost, including depreciation and repairs, may be reduced as low as 3 cents per acre-foot raised 1 foot, or even less; but the margin of profit in the ordinary farm crops is so small that the average irrigator can rarely afford to pay the cost of pumping water to a height of exceeding, say, 50 feet.

### DRAINAGE.

The correlative of irrigation is drainage. As above stated, all irrigation works must be accompanied by the building of adequate wasteways and drains. Throughout a great part of the United States outside of, as well as within, the arid region are thousands of acres of land which are either partly submerged, especially during the flood season, or contain an amount of water so large as to render their cultivation impracticable. Drainage must be provided for these lands, not only to remove the surface water but to decrease the percentage of water in the soil itself. There are thus necessary two distinct but closely related kinds of construction—first, the surface drains or wasteways, and, second, subsurface or deep, usually covered, drains.

Surface ditches form by far the greatest part of all drainage works. They are usually broad, shallow depressions designed to carry away as quickly as possible the excess of rain or flood water and to discharge this into the natural streams. By relieving the surface of this burden, it is often possible for the soil to quickly dry out and reach a tillable condition. In the case of some soils it is necessary to provide deeper outlets, which will actually draw down the water in the ground and permit the air to enter the interstices. In other words, the drains must be put down sufficiently deep to permit the escape of water from the upper 6 or 8 feet. What is desired is to reduce the percentage of saturation down to, say, 12 or 15 per cent.

### LOCATION OF DRAINS.

There is probably no one engineering operation that seems more simple than that of location of drains. Looking at the surface of the ground, the ordinary observer will infer that the drains should follow certain depressions. Acting under such impulses, thousands of dollars have been wasted in building drains which when constructed were found not to remove the excess water as anticipated. The reason is that the underground conditions are not usually revealed by the contour of the surface and that the movement of the water through the soil is covered by conditions of perviousness which are not at once apparent. These can be determined by a carefully planned series of test pits or bore holes so located as to ascertain the character of the subsoil and slope of the water table. For example, on the Shoshone project, in Wyoming, the soil, of 4 to 6 feet in thickness, is underlain by gravel. The general surface has a fall of about 20 feet to the mile. Apparently there could be no danger of swamping such an area, as water would flow down the surface or into the gravels. It was assumed that the gravel could deliver any excess water to the deeply cut natural drainage lines. As a matter of fact, however, swamps did develop on these relatively deep slopes, and drains built according to surface indications did not relieve the situation. Carefully conducted investigations showed that there were certain bands of gravel less pervious than others, and that only when the drains were so located that these bands were cut could the accumulated water be discharged through the barrier and the swampy conditions relieved. It was by thorough investigation that these unexpected conditions were found to exist in material which ordinarily is supposed to be readily traversed by water. Before undertaking any considerable drainage enterprise a map should be prepared showing not only the surface conditions but also the depth to hardpan, to the

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water table, and other facts such as may be ascertained by field examinations of the area. On the basis of this information it is possible to prepare plans which may enable large economies, as against the frequently haphazard system of simply digging the drains and then trying out their efficiency.

The amount of water which must be handled by any drainage system is, of course, the principal factor to be considered. Next in importance to this is the time during which the water may be handled or the period of duration of plant growth. Usually it is possible to ascertain with a reasonable degree of accuracy the quantity of water which may fall upon the surface or be received from higher grounds and to proportion the surface channels in such a way as to permit the taking away of this surface flow within a certain specified number of hours. The drawing down of the excess water in the soil, however, introduces the questions of the permeability of the soil and its ability to deliver water to the drains. If these are located too near the surface and in "hardpan," the water may not come freely to them. If, on the other hand, they are put at a depth of, say, 8 or 10 feet and in a pervious stratum of gravel, then the delivery of water may be rapid and complete.

The distance between drains, their size, slope, and other conditions must be worked out in accordance with the full information obtained by field examinations and by the analogies presented by successful work elsewhere. The development of drainage is proceeding rapidly as larger experience has been obtained and more complete information concerning the essential details.

### OPERATION AND MAINTENANCE OF THE WORKS.

In planning and constructing any works for irrigation and drainage the first requisite as above noted is that when built these may be operated and maintained at reasonable cost. While temporary expedients may be necessary, yet full consideration should be given to the future difficulties involved. The plans finally agreed upon should be prepared or passed upon by men who have had large experience in the operation and maintenance as distinguished from the mere engineering or construction side. All these works are built for indefinite use and are to be maintained presumably as long as civilization endures. The development of the resources in the country and location of industries are intimately connected with the irrigation or drainage works, and any error made in these may be indefinitely perpetuated with subsequent loss to all concerned.

In the case of drainage works the operation is practically automatic, and the maintenance should be extremely small, consisting in seeing to it that the drains are not clogged and that the inlets and outlets are properly protected. In the case of irrigation, however, where water should be measured and delivered at short intervals throughout the greater part of the year, it is necessary to have a carefully organized force of experienced men giving attention to all of the details of the control and diversion of water. The same or a similar force is called upon at certain times of the year, usually after the close of the irrigation season, to make the necessary repairs and give attention to the details of the maintenance or upkeep of the works, all of which may be greatly simplified or reduced by wise planning at the time of construction.

### SETTLEMENT PROBLEMS.

Although the engineer's responsibility connected with any work of irrigation or drainage is supposed to begin and end with the building, operation, and maintenance of the physical plant, yet, as a matter of fact, the engineer is more or less directly concerned with the matters of more purely human interest. No matter how well the works are planned and built, if, when they are put into

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operation, there arises conditions such that the farmers are not able to make a living or do not enjoy a fair share of prosperity, then the engineer's reputation suffers. He may have exercised rare skill and have overcome great obstacles and brought about unusual economies. All of these, however, are apt to be overlooked if the lands served by the works are not being handled in such a way as to yield satisfaction. For this reason the engineer, for his own protection if for no other cause, must take a broader view than that which merely embraces the physical conditions. He must see to it, as far as lies within his power, that the works are not only properly handled, but that other conditions are well met.

One of these important questions is that of the quick and proper settlement of the lands, of getting the reclaimed areas at the earliest practicable date into the hands of men who are competent to utilize the advantages. While, as before stated, this matter may not lie strictly within the province of the engineer, yet in making his plans and in executing them he should look far ahead and use every opportunity offered to develop methods which will bring about the use of the lands by competent farmers.

In general, it may be said that the greatest disappointment and financial loss, such as those incurred in recent years in schemes of irrigation and drainage, have come about through neglect of these vital questions of settlement and of the finances of the newcomers, most of whom are men without adequate capital. They must have available some funds or be provided with some credit. Rare discretion must be exercised in extending any aid. There was a time when it was assumed that if irrigation and drainage works were properly built there would be no delay in the lands being quickly utilized in the production of crops. Also that they could be sold immediately and at a profit to enable the farmer to make partial payment of his debts. This ideal condition has not been realized. On the contrary experience has shown that the work is truly pioneering and that while a few men do succeed, even though unprepared, the majority encounter difficulties such that they can not successfully remain on the land.

As a rule the kind of men attracted to a new enterprise are those who are relatively restless or who have not made good at home. Unless care is taken, men of this type will put down their last dollar in making the first payment for a piece of reclaimed land. They attempt to start a new and often unknown business with no capital and little experience without adequate shelter for their family and domestic animals and with a very scanty food supply. They hope that the first crop will enable them to pay some of the debts or at least secure credit. When, as frequently occurs, their first crops through lack of skill or through accident are of relatively small value, the disappointment and even hardship may be extreme.

No person should be permitted to purchase or take up a piece of newly reclaimed land without having an amount of money adequate for support during the first year or two. In addition, the family should be physically and mentally adapted to pioneering and not easily discouraged by the mishaps of a new country. Usually the price for farm products on any given project while the works are being finished are large. Later with an increased crop production exceeding the demands of the limited local markets, the prices suddenly drop. For example, alfalfa may sell to the contractors on the work at $12 per ton, this being made up of the price at other points of, say, $8 per ton, plus the freight of $4 per ton. When, however, the alfalfa fields on the new project produce an amount of hay more than sufficient for local demands the prices drop suddenly from $12 to $4. They are now based on the price in the outside market of $8 per ton, minus the freight of $4, leaving the net local price barely that of cutting and stacking. This simple illustration is typical of crops during

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the first few years before a large regular market has been established. During this period between the production of crops and creation of markets, such products, for example, as potatoes may be hardly worth digging.

Failure to anticipate these conditions, while not attributed to the engineer, has its reflex action in preventing the proper appreciation of work which he has so well executed.

### FINANCIAL RETURNS.

All of the work which has been considered is executed primarily in the hope of receiving directly or indirectly a large financial profit. If the works are built by a corporation, it is with the expectation that not only will the investment be returned but that this will be accomplished by a large earning as well as by a steady return of interest on the investment.

Even if the works are built by a community or by the Government, it is the expectation that while profit may not be made directly on the investment, yet the indirect return will far exceed the amount invested. As a matter of fact, while in the case of investments by the Government there has been a large benefit in increased population and better business facilities, yet the direct return has been small. In the case of private investors in irrigation works or securities, the return to the man who put in his money has been practically nothing. He has become an "involuntary philanthropist," in that his money has gone to benefit the country in general, but he himself has not been able to recover the amount expended. This is notably the case in the large irrigation works initiated within the past decade, most of which have passed into the hands of receivers. In short, the financial returns have not been commensurate with the risks involved. As a result little money is being invested in such works, excepting by the public or semipublic corporations expecting to derive indirect benefits.

From the history of the past, it is hardly to be expected that private capital will again enter upon the large irrigation enterprises such as those promoted between 1902–12, unless the investors have such ownership or control of the lands that they can recover for their own benefit practically all of the increase due to the construction of the works. It is possible to imagine that a large landowner may acquire such control. If in place of the large individual owner we assume an organization of all the property owners combined to make the improvements, it is possible to conceive how they may be able ultimately to receive the complete benefits of the investment. Such an organization is that which results from the formation of an irrigation district, one including all of the property to be benefited directly and indirectly, and one in which all such property is subject to taxation and becomes liable for the expenditure incurred, such liability being offset by the probability of receiving corresponding benefits.

The irrigation district thus appears to offer the best solution for the problem of further development of irrigation. The district and its component parts should be able to receive practically all of the benefits and should make payments according to the benefits. This condition is in contrast to the condition above noted where one set of persons or investors assume all of the financial responsibility and are able to recover only a portion of the benefits, the greater part of these going to the community as a whole. When this community, namely, the irrigation district, takes the place of the investors, then there is a fair apportionment of the risks and reward.

A similar condition exists with reference to drainage districts, excepting that these have not passed through the extreme experiences such as have the irrigation enterprises. There was less apparent gain to be made through

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building drainage works and a better appreciation of the fact that the benefits of drainage could not be made the source of speculative profit. Hence drainage districts have been organized on a more substantial basis and have had more nearly uniform success than irrigation enterprises. They illustrate even more clearly than do the irrigation works the fact that there must be thorough cooperation for success and that all of the property involved and which may be benefited should be held liable for the cost of these benefits.

The evolution of suitable irrigation laws and regulations has been slow. In the first laws too much latitude was left to the speculative element and too great responsibility was entrusted to the men elected as trustees, not for their irrigation experience or business ability, but more largely for purely personal or political reasons. In recent years many safeguards have been adopted to prevent reckless expenditure by such men and to assure competent supervision by experts in engineering and financial lines. With the experience of the past there is every reason to hope that the irrigation districts formed under revised laws and regulations may proceed with economy and efficiency to return fair reward for the investment made.

While the financial returns have not always been satisfactory, and probably never will be large, yet the indirect returns to the community, to the State, and to the Nation, are so great that the progress as a whole may be viewed with a certain degree of satisfaction. While it is true that incompetent and reckless men have rushed into enterprises and drawn others with them and which have lost to investors millions of dollars, yet the works have ultimately resulted often in the creation of material prosperity. There has resulted an extension of opportunities for farms and homes which in the aggregate far exceed the loss incurred. Unforunately, however, as before stated, the beneficiaries are not the men who risked their money, but others who were so fortunate as to come in after the principal difficulties had been solved.

By taking advantage of the lessons taught in the past it is possible to work upward to a steady development of the natural resources of every locality and every country where nature has been niggardly in the supply of water and where this lack may be remedied in part, or, on the contrary, to remove by drainage the excess on those lands where nature has been too lavish. With engineering skill guided by experience we may confidently expect to see a series of continually increasing and prospering self-supporting communities made possible by well-considered irrigation and drainage enterprises.

The CHAIRMAN. We will now proceed with the reading of the paper presented by Mr. A. P. Davis, director of the Reclamation Service, on the subject of "Engineering work of the United States Reclamation Service." The paper will be read by Mr. M. V. Ayres, of the Interstate Commerce Commission, Washington, D. C.

## ENGINEERING WORK OF THE UNITED STATES RECLAMATION SERVICE.

By ARTHUR POWELL DAVIS,

*Director and Chief Engineer, United States Reclamation Service.*

Agriculture by irrigation is one of the oldest occupations of civilized man. Various parts of the world show evidences that irrigation was practiced long be-

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fore any historical record was kept. The remains of prehistoric irrigation works have been identified and extensively traced in Southern Arizona, along the Salt River, and in parts of New Mexico and California.

As a modern activity of the Anglo-Saxon race, however, irrigation in the United States on any considerable scale seems to have had its beginning in Utah in the settlement of the Salt Lake Valley. The early settlements of California, New Mexico, and other arid States, extended the practice of the early Spaniards and the Indians, and irrigation development kept pace with the slow settlement of these then remote regions.

During the early history of irrigation, farmers and groups of farmers naturally confined their efforts mainly to diverting small streams upon adjacent valleys where the slope of the country and the topography was such as to make the work easy and cheap. With the values of land then existing no expensive enterprise was practicable. Such development proceeding for nearly half a century, widely distributed over the arid region, irrigated in the aggregate a very large area of land. The farmers employed the cheapest class of construction and seldom counted their own time in computing costs, which are hence reported very low.

As land values increased and the easier projects had been developed, more and more difficult ones were taken up, sometimes successfully and sometimes not. As the more difficult problems were attacked, corporate capital and the district system were employed and such projects as they could handle were gradually developed. The inherent difficulties, however, did not admit of much profit to the investor. In fact, in a majority of the cases, the investors lost a large part of their capital, to say nothing of interest and profits, and though the general benefits in the development of the country were great and lasting, the losses made it more and more difficult to enlist private capital in further irrigation enterprise.

Various laws were passed from time to time to encourage the irrigation of arid lands, the desert land act and the Carey Act, with their various modifications, being the most conspicuous examples, but all depending upon the investment of private or corporate capital for actual construction.

The increasing difficulty of carrying out many large projects led to the passage of the reclamation act, with the avowed and widely heralded object of enlisting national funds for the development of projects not feasible by private, corporate, district, or State enterprise. This policy, avowed in Congress and announced repeatedly by the President, was followed by the Reclamation Service.

The reclamation act provided for the establishment in the United States Treasury of a fund to be known as the reclamation fund, and to consist of the net receipts from the sales of public lands in the most western 16 States and Territories.

Under this act construction was commenced in 1903 and gradually extended to 15 of the 16 States enumerated in the original act. A later act added the State of Texas to those previously enumerated in order that a project might be taken up on the Rio Grande to irrigate land in New Mexico and Texas. Various other laws modifying the provisions of the original act in various ways have been passed from time to time, and in 1910 an act was passed to provide for the transfer to the reclamation fund of $20,000,000 from the general fund for the purpose of completing projects previously begun.

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The expenditures under the provisions of these laws have aggregated about $100,000,000 distributed over the following projects:

*Statement showing net investment of United States in reclamation work to June 30, 1915.*

| State. | Project. | Amount. |
|---|---|---|
| Arizona | Salt River | $10,431,275.09 |
| Arizona-California | Yuma | 7,678,853.92 |
| California | Orland | 787,961.02 |
| Colorado | Grand Valley | 2,359,251.08 |
| Do | Uncompahgre | 5,701,714.18 |
| Idaho | Boise | 10,905,760.89 |
| Do | Minidoka | 4,986,211.82 |
| Kansas | Garden City | 376,185.27 |
| Montana | Huntley | 1,162,854.63 |
| Do | Milk River | 3,882,213.68 |
| Do | Sun River | 2,248,381.34 |
| Montana-North Dakota | Lower Yellowstone | 3,203,581.06 |
| Nebraska-Wyoming | North Platte | 6,574,137.65 |
| Nevada | Truckee-Carson | 5,774,435.22 |
| New Mexico | Carlsbad | 882,899.37 |
| Do | Hondo | 367,257.11 |
| New Mexico-Texas | Rio Grande | 4,679,501.75 |
| North Dakota | North Dakota Pumping | 954,860.59 |
| Oklahoma | Lawton | 8,987.19 |
| Oregon | Umatilla | 1,786,918.19 |
| Oregon-California | Klamath | 2,386,946.99 |
| South Dakota | Belle Fourche | 3,312,883.84 |
| Utah | Strawberry Valley | 2,589,511.22 |
| Washington | Okanogan | 716,072.01 |
| Do | Yakima | 6,766,432.30 |
| Wyoming | Shoshone | 4,088,467.01 |
| Total | | 94,613,554.42 |
| Miscellaneous investigations | | 895,361.01 |
| Grand total | | 95,508,915.43 |

The projects undertaken, unlike the early simple diversions upon valleys adjacent to the headworks, involved on the contrary expensive storage works, high diversion dams, difficult tunnels, or long expensive canal work upon side hills, where large investment was necessary before any water was brought to the land.

Many of these projects involved works theretofore unprecedented in some respects, and many others which had no precedent upon irrigation construction with its limited possibilities concerning the values created.

In general the projects undertaken by the service may be divided into two main classes with reference to the economic conditions which obtained when the service took up the problem. The first class consists of those projects where irrigation had been undertaken by private enterprise, the natural flow of available streams diverted upon lands adjacent, and canal construction carried far beyond the available water supply in the low-water season. This condition was often carried to an extreme under the stimulus of a cycle of years when the water supply was above the normal, and when the inevitable lean years rolled around failure was often widespread and disastrous. Under such conditions the project undertaken has been the increase of the water supply, either by storage or by bringing other waters from a distance, always involving heavy work and expenditure and usually developing a water supply more than sufficient for the cultivated lands, thus allowing the project to be extended to cover new lands.

The other class of projects consists of those in which the development is entirely new, bringing under cultivation desert lands not previously irrigated. The majority of the projects constructed partake to a considerable extent of the characteristics of both these main classes.

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The Salt River project furnishes one of the most striking examples of comprehensive plans involving water storage, power development, pumping from underground, and pumping from gravity canals to higher lands. It is the largest project so far completed, involving the irrigation of 190,000 acres of land, and is a typical example of those projects where irrigation had been attempted by private enterprise and had been carried beyond the available water supply, so that in periods of abnormal shortage agricultural operations had received a disastrous check.

Lying partly in Arizona and partly in Colorado, the Yuma project involves the construction of a diversion dam in the Colorado River, and in the main the reclamation of lands previously desert; for, although a few feeble attempts at diverting the river on a small scale, or pumping water from it, had been previously made in the same valley, these attempts had been unsuccessful owing to the great physical difficulties to be overcome. The chief engineering works on this project are the long diversion dam, founded upon sand, with large concrete sluicing works at each end to dispose of the heavier sediment from the turbid waters of the Colorado; a tunnel to carry 1,400 cubic feet of water per second under the Colorado River, beyond Yuma, which was built under great difficulties by the pneumatic process, and the series of dikes to prevent the inundation of irrigated lands by the annual rise of the Colorado River. These dikes though comparatively simple in themselves, and perfectly efficacious in preventing inundations, nevertheless are difficult and expensive to maintain not against the high water for which they are built but against the erosion of the river current at moderate and low-water stages, which threatens the destruction of the levee in many places by undermining the banks upon which they stand. Extensive rock revetment has been introduced to combat this tendency.

In Colorado a large project of the first class has been undertaken and nearly completed by which the waters of the Gunnison River are diverted through a tunnel nearly 6 miles in length, under a mountain 2,000 feet above, into the Uncompahgre Valley, for the irrigation of about 125,000 acres of land, a portion of which had been previously served by an insufficient water supply. The construction of this tunnel presented unusual difficulties in high temperatures, annoying bodies of water and immense volumes of gas, which were liberated by the excavation. It has been in successful operation for three years.

The Boise project in Idaho, one of the largest undertaken, involves a variety of interesting engineering operations, including a masonry dam on the Boise River for storage purposes, having a height of 350 feet above its foundation, which makes it one of the notable structures of the world, being the highest dam yet constructed. In spite of its great magnitude this dam does not form as large a reservoir as some of the smaller structures, and additional storage for the water of the Boise River is necessary. The river is diverted by a masonry dam about 10 miles above the city of Boise and carried a distance of 35 miles through canals to a reservoir formed in the lower Boise Valley by the construction of two large embankments across gaps in the hills, forming a reservoir of 178,000 acre-feet capacity. This reservoir serves the lands lying under it, while the higher lands are served from the Arrowrock Reservoir on the river.

The Boise project illustrates an extensive practice found necessary upon some reclamation projects of distributing water through pipes constructed of concrete, wood, or steel, a large amount of concrete pipe having been used for crossing depressions and drainage lines with the irrigation conduits.

The Minidoka project in the same State diverts water from the Snake River by means of a rock-fill dam about 50 feet high, from which canals carry water to 80,000 acres of land. The dam also furnishes head for the use of a large

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amount of water which must flow to prior appropriators farther down the river. This water is here used for power development, and by its use is operated the largest single irrigation-pumping development in the West. About 10,000 horsepower is required by the pumps during midsummer and over 48,000 acres of land are served by an average lift of 68 feet. In addition to this, about 85,000 acres of land are irrigated by gravity from the canals heading at the same dam.

The Milk River project in Montana is interesting from its international character. It diverts the water of the St. Mary River above the point where that river flows into Canada, and carries it eastward into the Milk River basin for irrigation. The Milk River itself is also an international stream. The division of the waters of these streams is made by an international commission provided by treaty.

On the North Platte River is a very interesting interstate project serving lands in Nebraska and Wyoming. The Pathfinder Reservoir is formed by a rubble masonry dam built in a gorge below the mouth of the Sweetwater River and impounds 1,100,000 acre-feet of water. This water is applied to about 120,000 acres of desert land lying partly in Wyoming and partly in Nebraska, and additional canals are being constructed which will increase the area of the new lands to over 200,000 acres. In addition to this, the Pathfinder Reservoir serves storage water to more than a dozen private canals previously constructed, which were deficient in water supply in the latter part of the season.

This reservoir with its enormous capacity is designed to control the entire flow of the tributary basin during ordinary years and regulate it to the needs of irrigation. Abundant opportunities exist for utilizing this water, and these are limited only by the water supply.

Two small reservoirs have been provided upon the plains about 100 miles below the head of the main irrigation canal, which receive waste water from the main canal during the early and late portions of the irrigation season, and are available for storing the river flow below the Pathfinder Reservoir in the nonirrigating seasons.

The North Platte project furnishes one of the many examples of reclamation projects planned to utilize the water supply to the fullest possible extent. The accumulation of information during the years of its construction and the abundant opportunities for utilizing the water will make this plan feasible to a perfection not possible with any private development.

The Rio Grande project furnishes perhaps the best illustration of the complete and final utilization of the residual water supply of a great drainage basin. The Rio Grande has been used for irrigation for hundreds of years. The early Spanish settlers found water already artificially applied to land in this valley by the aborigines. This application was extended in the valleys of Mexico, Texas, and New Mexico, and at a later date, the headwaters of the same stream were diverted for irrigation in Colorado and northern New Mexico to an extent that encroached seriously upon the supply for the canals in the lower valley, and in years of deficient rainfall, was disastrous thereto. The Mexican Government filed a large number of claims against the United States for damages to irrigated lands in that Republic from such diversion. To settle these claims, to obtain a complete water supply for existing diversions and to add a large area of desert lands to the cultivated area, the Reclamation Service has constructed upon the Rio Grande, the Elephant Butte Dam, 300 feet in height, forming a reservoir which when filled will back the waters up the Rio Grande about 45 miles and have a capacity of 2,625,000 acre-feet.

The United States is under a treaty agreement to deliver 60,000 acre-feet of water per annum to the Republic of Mexico at the diversion dam near

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El Paso, and in consideration of such delivery the Mexican Government waives all other claims to the water of the Rio Grande at this point. In addition to this, about 160,000 acres of land in New Mexico and Texas will be furnished with a reliable water supply.

The Elephant Butte Reservoir has a capacity much larger than the total run-off of the Rio Grande at that point during any one year, and it is only during a series of years of relatively high run-off that the reservoir will fill. A record of 20 years of careful observation of the flow of the Rio Grande shows that under the uses to which it is proposed to put this reservior, there would have been no shortage of water, and some surplus would have run to waste during seven of the twenty years. In only two of those seven years, however, would the waste have exceeded 20 per cent of the capacity of the reservoir, and in the other 13 years no water would have been wasted.

The flow of the Rio Grande available at this point is, under the conditions presented, extremely erratic. The stream above is completely diverted for irrigation purposes over and over again, so that in years of normal supply the low water flow is practically all consumed in irrigation and the same is largely true of moderate high water stages, but the diversion capacity in the aggregate is small compared with the volume of the floods that sometimes visit the valley so that the net result of these diversions is to greatly accentuate the fluctuations and flow of the lower river. The river therefore is often dry or nearly so for long periods and anon is visited by destructive torrents so large, so violent, and so brief as to be of little use until controlled in a large reservoir, which utilizes a residual water supply in the lower basin not available without the enormous reservoir capacity to accumulate the flow of the cycle of plentiful years for use in the recurring cycle of dry years.

Considering the extremely erratic flow of the river at this point, the complete utilization of water in irrigation and the absolute prevention of destructive floods in the valley below is a remarkable achievement for the Elephant Butte Reservoir, made possible only by its enormous capacity.

The Umatilla project in northern Oregon has several interesting characteristics. It is in a country of rolling sandhills difficult of subjugation, but having a salubrious climate and very fertile when once subdued. The waters of the Umatilla River are stored by means of a diversion canal carrying water to a reservoir constructed on a tributary drainage line, and these are distributed through a series of canals which on account of the sandy nature of the country are largely lined with concrete and are supplemented by extensive systems of pipe lines made necessary by the rough topography of the irrigated region. Upon this project was the first demonstration of the feasibility of using large concrete pipes under high heads in the distribution of irrigation water. One example consists of a pipe line 46 inches in diameter more than 10,000 feet in length under a maximum head of 110 feet. No perceptible leakage has occurred from this line although it has been in use several years. The practice on this and other projects has been to manufacture the pipe in sections at some point convenient to raw materials where the work can be done with a perfection which could not be obtained in the field. These sections are hauled to place and carefully jointed during the coldest weather in which such work can be done, so that under ordinary conditions the line is placed in compression by the higher mean temperature. In this respect the climate of Umatilla is favorable for good results as it is practicable to carry on this work during the winter season which would not be the case in a colder climate.

The Belle Fourche project is one of the second class of projects, the land reclaimed having been in a desert state prior to its construction. The waters

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of the Belle Fourche River are diverted just below the town of Belle Fourche into a reservoir formed by a large earthen dam thrown across Owl Creek. This dam is one of the boldest structures constructed by the service and one of the most successful. It is about 115 feet high and its side slopes average about 2 to 1. The water slope is paved with concrete blocks 8 inches in thickness. It stores about 200,000 acre-feet of water, which is used in irrigating nearly 100,000 acres of land.

In Strawberry Valley, Utah, a reservoir of 250,000 acre-feet capacity has been constructed and the waters are diverted through a tunnel nearly 20,000 feet in length driven through the Wasatch Range to the westward, being discharged into a tributary of the Spanish Fork River, from which the water is diverted and supplies about 20,000 acres of desert land and perfects the supply for a similar area of land previously served.

An incident to this construction work was the development of power which is now being used for lighting and other purposes in several towns on the project.

The smallest project now being operated by the Reclamation Service is the Okanogan project, recently completed, in northern Washington. For this project water is stored on Salmon River by means of a dam built by the hydraulic process of earth and loose rock. Two power plants have been constructed at drops in the canal system and electric current is generated for pumping water from the Okanogan River on some of the lower lands of the project. These lands can also be served from the reservoir when the water is sufficient, and in years of plentiful supply it will not be necessary to operate the pumps, but they are indispensable to prevent shortage in low-water years. This project irrigates over 9,000 acres of land previously desert and serves a small area in addition with a better supply than formerly. It is situated in an excellent fruit region and is one of the most intensively cultivated projects of the service.

The Yakima project in Washington is one of the largest, most comprehensive, and most attractive projects of the Reclamation Service. It provides for the storage of the waters of the Yakima River in Kachess, Keechelus, Clealum, and Bumping Lakes and their diversion below in several regions. One of the branches of this project, called the Tieton unit, involves a series of concrete flumes and tunnels over 9 miles in length upon a steep mountain side and irrigates about 30,000 acres of very hilly land just west of the city of North Yakima.

Over 100,000 acres of land are also irrigated from the Sunnyside Canal, in the lower part of the Yakima Valley, from which two branches carry water across the Yakima River in pressure pipes, one of these passing under the river and the other being carried upon a bridge across the stream.

The Shoshone project, in northern Wyoming, is one of the best examples of a project devoted purely to the reclamation of desert land not previously utilized in any manner. The late summer flow of the Shoshone River was previously appropriated and the supply for the Shoshone project was obtained by the construction of a dam in a gorge 8 miles above Cody, just below the junction of the North and South Forks of the Shoshone River. This dam is 328 feet above its lowest foundation, and at the date of its construction was the highest dam in existence. It has since been exceeded by the Arrowrock Dam on the Boise River. The reservoir has a capacity of 456,000 acre-feet and is ample to control the flow of the Shoshone River in ordinary years and adapt it to the needs of irrigation. The dam is built of concrete, curved to a

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radius of 150 feet, and depends for its stability upon arch action. It is similar in design to the Pathfinder Dam, being 10 feet thick at the top with a batter of 15 per cent on the water side and 25 per cent on the lower side to the river bed, below which both sides are vertical.

Although the Shoshone River has a rapid fall it flows in a deep course, and its diversion involved the construction of a tunnel about 3 miles in length in order to carry water to the top of the adjacent benches.

The attached table shows the volume of engineering work completed to date:

*Summary of construction results, June 30, 1915.*

| Items. | June 30, 1915. | June 30, 1914. | Increase. |
|---|---|---|---|
| **Lands:** | | | |
| Estimated area 29 projects on completion— | | | |
| Acres | 3,017,970 | 2,921,165 | 96,805 |
| Farms | 59,400 | 58,323 | 1,077 |
| Estimated area service was prepared to supply water to— | | | |
| Acres | 1,474,345 | 1,343,193 | 131,152 |
| Farms | 29,730 | 27,115 | 2,615 |
| Under contract— | | | |
| Water rights— | | | |
| Acres | 461,666 | 416,644 | 45,022 |
| Farms | 10,122 | 8,559 | 1,563 |
| Rental contracts, etc.— | | | |
| Acres | 624,970 | 566,843 | 58,127 |
| Farms | 12,965 | 12,416 | 549 |
| Total— | | | |
| Acres | 1,086,636 | 983,487 | 103,149 |
| Farms | 23,087 | 20,975 | 2,112 |
| Reservoir capacity available.....acre-feet.. | 7,020,361 | 5,460,510 | 1,559,851 |
| **Canals, ditches, and drains:** | | | |
| Over 800 second-feet capacity.....miles.. | 389 | 325 | 34 |
| 301 to 800 second-feet capacity.....do.... | 610 | 538 | 72 |
| 50 to 300 second-feet capacity.....do.... | 1,480 | 1,318 | 162 |
| Less than 50 second-feet capacity.....do.... | 6,311 | 5,826 | 485 |
| Total canals.....do.... | 8,760 | 8,007 | 753 |
| Ditches and open drains.....do.... | 840 | 548 | 292 |
| Grand total canals, ditches, and drains.....do.... | 9,600 | 8,555 | 1,045 |
| **Tunnels:** | | | |
| Number | 87 | 86 | 1 |
| Length.....feet.. | 132,818 | 129,341 | 3,477 |
| **Dams, storage and diversion:** | | | |
| Masonry.....do.... | 1,977,857 | 1,346,904 | 630,953 |
| Earth.....do.... | 9,115,399 | 8,817,236 | 298,063 |
| Rockfill.....do.... | 967,147 | 704,784 | 262,363 |
| Total.....do.... | 12,060,303 | 10,868,924 | 1,191,379 |
| **Dikes and levees:** | | | |
| Mileage | 88.2 | 85 | 3.2 |
| Volume | 3,942,391 | 3,790,950 | 151,441 |
| **Canal structures:** | | | |
| Costing over $2,000— | | | |
| Concrete | 730 | 645 | 85 |
| Wood.....cubic yards.. | 107 | 75 | 32 |
| Costing $500 to $2,000— | | | |
| Concrete | 1,482 | 1,264 | 218 |
| Wood.....cubic yards.. | 323 | 206 | 117 |
| Costing $100 to $500— | | | |
| Concrete | 6,696 | 5,978 | 718 |
| Wood.....cubic yards.. | 4,129 | 3,748 | 381 |
| Costing less than $100— | | | |
| Concrete | 7,226 | 5,622 | 1,604 |
| Wood.....cubic yards.. | 44,154 | 37,087 | 7,067 |
| Total—Concrete | 16,134 | 13,509 | 2,625 |
| Wood.....cubic yards.. | 48,713 | 41,116 | 7,595 |

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*Summary of construction results, June 30, 1915*—Continued.

| Items. | June 30, 1915. | June 30, 1914. | Increase. |
|---|---|---|---|
| **Bridges:** | | | |
| Steel— | | | |
| Number | 85 | 84 | 1 |
| Length, feet | 5,433 | 5,337 | 96 |
| Combination— | | | |
| Number | 240 | 195 | 45 |
| Length, feet | 7,311 | 6,094 | 1,217 |
| Wood— | | | |
| Number | 4,013 | 3,386 | 627 |
| Length, feet | 85,702 | 70,603 | 15,099 |
| Concrete— | | | |
| Number | 284 | 210 | 74 |
| Length, feet | 3,740 | 3,191 | 549 |
| Total—Number | 4,622 | 3,875 | 747 |
| Length, feet | 102,186 | 85,225 | 16,961 |
| **Culverts:** | | | |
| Concrete— | | | |
| Number | 1,273 | 1,120 | 153 |
| Length, feet | 61,112 | 51,105 | 10,007 |
| Metal— | | | |
| Number | 1,146 | 880 | 266 |
| Length, feet | 40,119 | 26,338 | 13,781 |
| Terra cotta— | | | |
| Number | 567 | 306 | 261 |
| Length, feet | 29,052 | 16,191 | 12,861 |
| Wood— | | | |
| Number | 2,728 | 2,329 | 399 |
| Length, feet | 62,663 | 54,628 | 8,035 |
| Total—Number | 5,714 | 4,635 | 1,079 |
| Length, feet | 192,946 | 148,262 | 44,684 |
| **Pipe:** | | | |
| Concrete | 482,421 | 454,584 | 27,837 |
| Metal | 193,385 | 153,628 | 39,747 |
| Terra cotta (tile) | 634,108 | 451,928 | 182,180 |
| Wood | 260,676 | 192,036 | 68,640 |
| Total | 1,570,590 | 1,252,186 | 318,404 |
| **Flumes:** | | | |
| Concrete— | | | |
| Number | 33 | 29 | 4 |
| Length, feet | 4,189 | 3,123 | 1,066 |
| Metal— | | | |
| Number | 407 | 297 | 110 |
| Length, feet | 112,533 | 90,126 | 22,407 |
| Wood— | | | |
| Number | 1,461 | 1,264 | 197 |
| Length, feet | 335,324 | 328,375 | 6,949 |
| Total—Number | 1,901 | 1,590 | 311 |
| Length, feet | 452,046 | 421,624 | 30,422 |
| **Canal lines:** | | | |
| Concrete, miles | 140.5 | 85.4 | 54.1 |
| Wood, do | 3.0 | 1.7 | 1.3 |
| **Building:** | | | |
| Offices, number | 75 | 74 | 1 |
| Residences, do | 520 | 483 | 37 |
| Power plants, do | 19 | 13 | 6 |
| Pumping stations, do | 64 | 63 | 1 |
| Barns, storehouses, etc, do | 390 | 385 | 5 |
| Total | 1,068 | 1,018 | 50 |
| **Wells:** | | | |
| Number | 367 | 361 | 6 |
| Depth, feet | 29,337 | 28,717 | 620 |
| **Communications:** | | | |
| Roads, miles | 784 | 733 | 51 |
| Railroads, do | 82 | 78 | 4 |
| Telephone lines, do | 2,554 | 2,376 | 178 |
| Phones, number | 1,069 | 1,003 | 66 |
| Transmission lines, miles | 429 | 402 | 27 |



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*Summary of construction results, June 30, 1915*—Continued.

| Items. | June 30, 1915. | June 30, 1914. | Increase. |
|---|---|---|---|
| Power developed: | | | |
| Water horsepower | 29,676 | 29,126 | 550 |
| Steam horsepower | 4,250 | 4,250 | ..... |
| Total horsepower | 33,926 | 33,376 | 550 |
| Excavation: | | | |
| Class 1, earth.....cubic yards.. | 115,242,073 | 100,432,925 | 14,809,148 |
| Class 2, indurated material.....do.... | 8,178,469 | 6,668,156 | 1,510,313 |
| Class 3, rock.....do.... | 7,286,195 | 6,067,391 | 1,218,804 |
| Total | 130,706,737 | 113,168,472 | 17,538,265 |
| Coal mined.....tons.. | 47,684 | 39,474 | 8,210 |
| Riprap.....cubic yards.. | 1,023,398 | 616,493 | 406,905 |
| Paving.....square yards.. | 616,755 | 564,037 | 52,718 |
| Concrete placed.....cubic yards.. | 2,671,338 | 1,933,263 | 738,575 |
| Cement used.....barrels.. | 2,507,126 | 1,965,499 | 541,627 |
| Cement manufactured by United States.....do.... | 338,452 | 338,452 | ..... |
| Sand cement manufactured by United States.....do.... | 1,177,215 | 597,916 | 579,299 |

The CHAIRMAN. The next paper to be presented is on the "Irrigation work of the United States Indian Service," by Mr. W. M. Reed.

## IRRIGATION WORK OF THE UNITED STATES INDIAN SERVICE.

By W. M. REED,

*Chief Engineer, United States Indian Office, Department of the Interior.*

### PREHISTORIC.

When the first Spanish explorers penetrated the region in the Southwestern United States now comprised in the States of Arizona and New Mexico they found there existing a state of civilization in advance of that prevailing in the eastern and humid parts of the New World.

They also found evidence, in the ruins of houses and canals, which led them to believe that a much higher state of civilization had existed in this locality in the past, and that the people who had reached that higher plane had either been exterminated, had migrated, or had been conquered by a stronger and savage race, who, though perhaps not totally exterminating them, had absorbed them and their ways and turned the course of human life into a retrogressive instead of a progressive channel.

These facts and conclusions are mentioned in the writing of several of the early explorers, and Francisco Vasquez de Coronado, in his letters to his Government, refers to the architecture and other structures, the ruins of which he found, as evidence that a race superior to the one which he encountered had previously inhabited this area.

It is quite evident that in this region, the most arid of the United States, there existed several centuries—perhaps it might be safe to say many centuries—ago a state of civilization in advance of any other existing in any part of the present limits of the United States at that time, and perhaps on a plane with the civilization of that period of the so-called Old World.

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### EARLY IRRIGATION BY THE INDIANS.

The Indians in this great arid portion of the United States were skilled in the methods of irrigation when first visited by the explorers. They were an agricultural people, raising grains and in some sections cotton. They were using irrigation structures of great magnitude, constructed at an enormous expense of labor and maintained only by a stubborn fight against the devastating elements which threaten works of this kind in the arid climates. They evidently cared little for the chase, and preferred to use their energies in pursuits that led to a higher state of civilization rather than waste their lives and treasure in war.

On all sides of them, however, were hordes of savages who made war upon them frequently enough to derive a part of their own subsistence from the granaries of these peaceful people, thereby, to a certain extent, receiving a portion of their living from the results obtained by irrigation.

The savage tribes have been driven from place to place and have often faced starvation and extinction, but with the agricultural people it is different. Some of these tribes are living upon the same ground, using the same ditches, and in some cases employing the same methods to-day as when first discovered by the Spaniards in 1540.

Perhaps they have not advanced as they should, having had such an advantage in the art of agriculture by the use of irrigation, but there have been circumstances surrounding them that may be cited as a reason why progress has been slow and why it has been a worthy feat to maintain the conditions in statu quo.

In the early days it was a struggle against the man who wanted the food they had raised, the product of their labor, without compensation; it was a struggle against the savage. In later days it has been a struggle against the man who wanted their property, their lands and their supply of irrigating water, often without just compensation; it has been a struggle against the more civilized man, and without aid from the Government the Indian would undoubtedly have succumbed to the latter and at best to-day would only be a penniless outcast.

The white man learned not only from the Indian about the benefits and advantages of irrigation, but sought knowledge from all available sources and is in a position to outstrip his dark-skinned brother and wrest from him that which is rightfully his.

### ORGANIZATION OF A GOVERNMENT BUREAU TO ADMINISTER INDIAN AFFAIRS.

Early in the existence of the Government of the United States it became apparent to those in charge that the large population of Indians within its borders made the Indian problem a large one. Therefore, when the War Department of the United States was created by Congress in 1789, among the duties assigned to it were those "relative to Indian affairs."

In 1824 a Bureau of Indian Affairs was organized in the War Department. This, however, was without legislative authority. By act of July 9, 1832, Congress created the office of Commissioner of Indian Affairs, but the real organic act was the one of June 30, 1834, "to provide for the organization of the Department of Indian Affairs."

Upon the creation of the Department of the Interior on March 3, 1849, the Bureau of Indian Affairs was transferred thereto, and hence passed from military to civil control.

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### INDIAN BUREAU ACTIVITIES IN IRRIGATION MATTERS.

During the period of military control a large part of the United States was unsettled and an abundance of game existed. It was not then thought necessary to begin to instill into the minds of the Indians ideas of civilization. It was only necesssary to prevent them from committing depredations on the white population, and occasionally, when through tribal strife or unfavorable conditions of the elements they faced extreme hardship, to relieve their distress. However, soon after the bureau passed from the control of the War Department to that of the Interior, plans for bettering the industrial conditions of the Indians were undertaken.

The great Southwest, which formerly belonged to Mexico, had now become a part of the United States. This had increased the Indian population, bringing in some of the most peaceful and progressive and also some of the most savage and nonprogresssive. It brought new problems before the Government and required new methods in the Indian Bureau in order to successfully handle the situation.

Irrigation at that time was better understood by the Indian than by the white man, and in the earliest stages of development the so-called teacher was really learning from the pupil.

The Indian knew what was required—that the water from the streams should be applied to the lands in order to raise crops—and did succeed in accomplishing this, but by slow and laborious methods. The white man at first knew little of irrigation methods or results and really did not favor its practice, but when once convinced of its utility brought into use his knowledge of engineering methods and constructed and extended the work in a more practical and less expensive manner.

The greatest progress, however, has been among the Indians, who for many generations have lived from agricultural pursuits. The warrior and hunter is passing through what to him is a terrible ordeal. His hunting grounds are gone, he is confined within a certain restricted district, and must change his methods of living. In order to avoid the "melting pot" a little longer he must live from the resources of his reservation; he must live from agricultural and stock-raising pursuits; and as most of the reservations are situated within the arid or semiarid portions of the United States, irrigation must be practiced in order to succeed.

So great became the necessity for a thorough and systematic development of the irrigation resources of the various reservations, that the Bureau of Indian Affairs created within itself an irrigation branch several years ago and has increased and perfected this force as necessity demanded, until now the branch is of considerable magnitude and plays an important part in the uplift and civilization of the Indians throughout the entire arid section of the United States.

### ORGANIZATION OF THE IRRIGATION BRANCH.

The arid section of the United States, for the purpose of administration, is divided into five districts (see diagram, p. 295). This was done with a view of better and closer supervision, and the districts were located with a view of equalizing the amount of work under each superintendent. Facilities of travel were also taken into account, this being an important feature, as the Indian reservations are scattered over a large area, and for purposes of supervision they must be grouped so as to demand the minimum of travel in giving the proper supervision.

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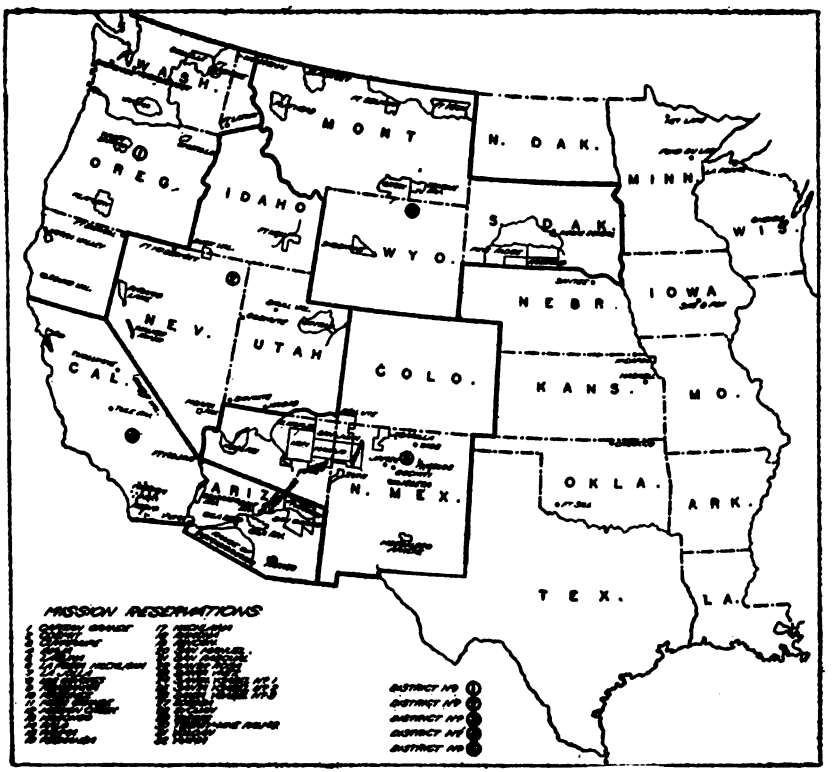
The field organizaton, which is under the direction of and reports to the commissioner's office, is as follows:

One chief inspector of irrigation, who acts as chief engineer; one assistant inspector, who acts as assistant chief engineer.

Seven superintendents of irrigation. Five of these are assigned to the various irrigation districts as the field executive heads; one has the general supervision of the purely mechanical work in all districts; and one is an attorney with a special knowledge of irrigation law, whose duty takes him to all districts, where he advises in all legal matters. He is specially charged with the protection of the rights of the Indians to sufficient water for all their needs.

Under each superintendent of irrigation in charge of a district are engineers,




Five Irrigation Districts.

assistant engineers and their assistants, and also superintendents of construction and foremen, mechanics, laborers, etc. There is also at each district headquarters a disbursing officer and small clerical force sufficient to take care of the strictly field business.

As irrigation work is one of the elements used in the civilization of the Indian, but a very small part of the work done by the irrigation force is contracted. The Indians' services are utilized for all purposes as far as they are available and competent.

A large part of the common labor is performed by the Indians, and in an increasing amount the skilled labor is also being taken up by them. In some cases an Indian foreman has proven quite efficient. A number of the young

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Indians who return from the Indian schools where manual training is a prominent part of the school work, take to mechanical work and become efficient and valuable workmen.

Investigations are being continually made of the possibilities of irrigation on the various reservations, it being the plan to develop the projects approved only as fast as the necessities of the Indians demand, or as legal complications, such as protection of water rights, etc., make necessary, but to secure the necessary data ahead, in order to be ready to take up and prosecute work the moment it is needed.

The field irrigation force is therefore at all times carrying on reconnaissance surveys, complete and detailed surveys, preparation of plans and estimates, construction, and irrigation—the actual application of the water to the land.

The projects to be investigated vary in size from 40 acres to 120,000 acres in area, and the development varies from the simplest kind of diversion and contour canal with simple structures, to the more complicated, involving storage reservoirs, difficult canal work, complicated structures, hydroelectric development, pumping from deep wells and distributing water to the lands through impervious conduits.

On some of the reservations the value of water is low, and expensive construction is not justified in order to prevent small losses; while on others, for instance southern California, the value of water reaches as high as $75,000 to $100,000 per second foot, and demands expensive construction that will prevent the waste of a single pint.

The accompanying table is an abstract of what has been accomplished, and a forecast, from the information at hand, of what is possible on the Indian reservations in the arid portion of the United States.

It is perhaps interesting to note that there are more than 115 projects of all sizes, upon which irrigation is or can be installed; that more than 94,000 Indians can be benefited; that there is now under constructed ditches more than 460,000 acres of land; that it is possible to increase this area until more than 1,500,000 acres will be under irrigation; that to-day the Indians are actually farming by irrigation methods 104,000 acres that another 43,000 acres of their land is being leased to and farmed by white men and that nearly 34,000 acres of Indian land has been sold to white men and is now being irrigated from the Indian irrigation systems.

The Indian Service has already expended nearly $12,000,000 in irrigation construction for the Indians, and it will be noted in the table that it is estimated that $27,000,000 more will be required to develop up to their capacity the projects existing on the various reservations in the arid section.

The total amount already expended and the amount required to fully complete all the projects seems quite large; but when considered from an acreage basis it will be seen that the cost is quite reasonable when compared to the average cost of irrigating lands in the arid portion of the United States.

The Indian has not embraced his opportunities for the development of lands to the same extent that white men probably would have done. However, behind the white men are many generations of civilized ancestors, while many of the Indians were born in a state of savagery and most of them are not more than one generation removed from that state. Their advancement has been thought by many to have been slow, but who can point to a race which in one or two generations has risen from the depths of savagery to the plane of civilization upon which the American Indian stands to-day?

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CONCLUSIONS.

The savage in the process of evolution to the status of a civilized man must develop all his latent faculties, and perhaps most often first shows signs of advancement in the agricultural and mechanical arts; and long before he is a poet or other literary genius, he is a successful farmer or skilled mechanic. Farming by irrigation is acknowledged as the highest and most scientific type of farming, and therefore is it not safe to conclude that the Indian, with his environment, with his natural tendencies and the tendencies of this particular era, will profit more from the Government's activities in irrigation development than from any other single activity in its program for the civilization of the American Indian?

The CHAIRMAN. The next paper is entitled "The combination of water resources for irrigation and power development," by Mr. George G. Anderson, of Los Angeles. This subject, in my opinion, is becoming more and more important. The coordination of water power and irrigation bids fair to settle, and, indeed, in many places has already settled, the controversies and many of the troubles that have arisen as to the use of water both for irrigation and for power. Indeed, I know of one locality in which the use of water for irrigation has been coordinated with the use of water for power to such an extent that old controversies have been smoothed out. During the past irrigation season an entire irrigation district voluntarily gave up nine-tenths of the water to which it was entitled under prior appropriation in order that a water-power plant might continue in service and serve in turn irrigators living in adjoining areas, who were dependent upon water pumped by hydroelectric power. Mr. Fuller will kindly read Mr. Anderson's paper.

## THE COMBINATION OF WATER RESOURCES FOR IRRIGATION AND POWER DEVELOPMENT.

By G. G. ANDERSON,

*Consulting Civil Engineer, Los Angeles, Cal.*

The uses to which hydroelectric energy can be applied in connection with irrigation development are many and varied, as a moment's reflection will reveal. Apart altogether from the application of irrigation to extended areas, beyond the original scope of the project itself, there are the minor uses of power through the settlements built up in the cultivation of the irrigable area, for domestic lighting and heating, and for the innumerable purposes in connection with the farm buildings, for which electric power is steadily, in fact rapidly, displacing hand labor. These have been called minor uses, but, as will be briefly referred to later, they have been shown in some instances to be of such importance as to justify operation in certain seasons that would otherwise be unprofitable.

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On strictly physical considerations the combination of power development with irrigation works does not, at first glance, appear to be practical, or, in the larger sense, economical. The primary consideration in irrigation construction is, naturally, the conservation of water and elevation. The development of electrical energy by water power involves the dissipation of the latter element—elevation. On first thought it does not seem that such dissipation can be made on irrigation works without great loss of territory. And the use of water for power production, viewed from the same standpoint, would seem to imply a loss of water for irrigation purposes or to necessitate the employment of secondary storage reservoirs, in which to impound the waters so used for power, to be carried over to the periods when required for application to irrigation purposes.

That view of the combined development applies to irrigation as practiced under conditions where elevation must be economized, so to speak, to cover territory, first, and to afford only the requisite canal gradients; second, irrigation systems in which the main canals are so located that sudden, sharp changes of gradient exist are rare. Where they do exist, power can be developed by utilization of the difference in elevation between the two "benches," without involving any material loss of water. Ordinarily such loss of water would not be economical, broadly speaking, the necessity for irrigation implies a scarcity of water, or if not actual scarcity, at least a condition when all the available supply can be economically and profitably utilized.

Extending the viewpoint to some extent, the second impression is that an alliance of power development with irrigation would not be practicable, because the generation of power is, or becomes, a continuing necessity, while, in the greater field in which irrigation is practiced, it is only during a more or less limited period of the year, when water is applied to the land. Following out that thought, the practice is, that during the non-irrigation season the water supply is conserved in storage for use in the irrigation season, to the extent, in the older and more highly developed irrigation regions, of completely conserving the available supply. In the accomplishment of that desirable result it would appear that the use for power development throughout the entire year would not contribute, but, on the contrary, would reduce the storable quantity by the amount required for power purposes unless, as has been previously suggested, there could be secondary storage reservoirs of ample capacity for the needs of the irrigable area, in volume, and so located as to afford the sufficient service in respect to elevation; and upon the lower levels, or, as one may say, the plains level as applied, broadly, to the irrigation regions, the number and extent of such secondary storage reservoirs are few and limited.

Such conditions exist in large measure through the irrigation region and, perhaps, more peculiarly to the older districts where irrigation has been practiced for the longest period. And it is therefore true, that the instances of the combination of water-power development and irrigation development are not numerous. It is probably also true that conditions exist in the older regions similar to those in the newer, where such combinations have been installed, and that equally beneficial results would be obtained by such development in those older regions.

It has been said that "combination projects for both irrigation and power * * * can often be made highly profitable where commercial success for either project alone would be impossible." (Engineering Record, vol. 60, p. 695.)

Without stopping for the moment to consider that phase of the subject, it remains to be pointed out that, in the later developments, there are some phases of the application of power that materially aid irrigation development, simply as such.

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It frequently occurs that above the highest elevation upon which canals to serve irrigable areas by gravity can be economically constructed, there are large areas of land of fine quality. These would remain in the arid condition but for the fact that they can be served by water pumped from the gravity canal by power generated from water carried in it.

In addition to that the irrigated area lying under the gravity canal can be materially extended by applying water pumped from underground sources to the adjacent area and applying the water diverted from the stream by the gravity canal to the more remote regions.

Again, the experience of nearly all irrigation projects has been that areas of lowland become overirrigated and eventually required to be drained. Ordinarily surface drainage is not possible of complete effectiveness, which can be secured by pumping, when the excess waters can be delivered to ditches and again applied to areas needing irrigation.

These are the general conditions under which hydroelectric energy and irrigation supply can be developed economically in combination. Brief reference will be made to a few instances of such developments as have been made, not in any sense intended to be comprehensive but rather illustrative.

On the Bear River, Utah, an irrigation system has been projected with canals on each side of the river. These were subsequently connected by siphon, leading both canals to the power house for electrical development, serving the purpose not only of power development, but of improved service on the irrigation system, permitting the service of water supply to both canals from either intake. The streams afforded an ample water supply for power purposes during the nonirrigation season and the earlier part of the irrigation season, leaving a somewhat diminished volume during the remainder of the season. (Engineering News, vol. 53, p. 375.)

At Bingham City, Utah, a power development was made in combination with a system used largely for domestic purposes, for which there was little or no direct irrigation. Irrigation was, however, made possible by the pumping of water from wells, ranging from 12 to 35 feet, a satisfactory water supply thus being obtained, while there was only a limited supply from the direct stream flow.

The cost of pumping from depths of 20 feet for the supply of from 40 to 50 acres was about $1.50 per acre for the season compared with the average cost of maintenance and operation of gravity canals in the neighborhood of $1.25 per acre. (Engineering News, vol. 54, p. 235.)

The Davis and Weber Counties Canal is one of the early irrigation ditches in Utah, diverting about 425 cubic feet per second from the Weber River.

The Riverdale Hydroelectric Plant enlarged the canal, adding 300 cubic feet per second to its capacity, and from another ditch 18 cubic feet per second more, and generates power for lighting and commercial purposes in the city of Ogden and for interurban service between Salt Lake and Ogden.

All of the water supply is available for power purposes from September 15 to April 15 and 318 cubic feet per second during the balance of the year.

When the power development was made the canal was improved by lining it with concrete to prevent the loss by seepage in transportation.

Formerly nearly 25 per cent of the water was lost in passing down the canal and 12,000 acres only were supplied with water. This loss has been eliminated entirely with the consequent increase of the irrigated area and a better supply of water, an economy of double value. (Engineering Record, vol. 66, p. 652.)

In connection with the Minidoka project, Idaho, United States Reclamation Service, the combination of gravity and pumped water supply has been made. There are altogether 122,000 acres served by water on both sides of the Snake

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River, of which 71,000 acres are under gravity canal and the balance supplied by pumped water. The total water supply is in excess of the requirements. (Engineering News, vol. 66, p. 4.)

Some interesting details of the features of this power plant and the uses to which the power is applied, including the electric heating of the local high school, are given in the Reclamation Record for April, 1914. Ten thousand horsepower is developed, 90 per cent of which is required during the irrigation season, but the plant would be idle during the winter except for the extensive use of power in the towns and on the farms for heating and cooking as well as for light and power. Household use includes lighting, ironing, washing machines, vacuum cleaners, and cookstoves—a statement which aptly summarizes the varied uses to which hydroelectric energy can be applied in combination with irrigation development.

In closing, reference may be made to the fact that in some few localities the water used for the generation of hydroelectric power may be applied to irrigation purposes below the lowest power house. An instance of that occurs in southern California, where irrigation had not been practiced to any considerable extent prior to the power development, largely due, presumably, to the prohibitive cost of bringing water to the lands solely for irrigation purposes. So far as known the combination has not been operated sufficiently long to test the accuracy of the judgment that the combination project can be made highly profitable for both "where commercial success for either project alone would be impossible." Commercial success could not have been secured for the irrigation project alone, while, on the other hand, such success did attend the power project alone. It is, however, an example of one development following upon the other, though ordinarily the reverse order has been observed.

Mr. FULLER. It seems to me, in connection with irrigation projects, that the one thing necessary is the combination of power and irrigation. I have seen many examples where, for instance, an irrigation project might supply certain lands, and yet power could be developed in conjunction with the project, and the power so developed could be used for pumping water against abnormally high heads. The mere fact that the load factor seems to follow in, occurring at a time when the irrigation water supply is plentiful, meets an ideal irrigation project condition. In connection with irrigation projects I think the power feature or the power possibilities should be investigated carefully and thoroughly.

The CHAIRMAN. This completes the list of papers on the afternoon's program. The papers have covered a very wide range of irrigation and drainage subjects. I have no doubt there are some here who wish to discuss the papers. I am informed that Señor Mercau, of Argentina, will discuss the paper through the interpreter.

Señor MERCAU. I desire to make a general statement about this irrigation plan. The authors have treated only the actual engineering features of the projects and have not dealt with the legal procedure relating to these works of irrigation. I would suggest, therefore, if this congress shall see proper to do so, that you adopt a resolution, so that the next congress will study the different legal

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proceedings in the different countries. They differ very much in each of the South American countries from the legal procedure in the United States; that is, as referring to irrigation and sources of power. I thank you.

The CHAIRMAN. The suggestion is one that has been followed with respect to water power. A paper was read yesterday by Mr. Rome G. Brown, of Minneapolis, before Section V, which went somewhat extensively into laws concerning water power. This proposition concerning the laws with respect to irrigation comes, I believe, with considerable force. Is there any suggestion in regard to the subject? Perhaps it would be a good idea to ask Señor Mercau to draft such a resolution as he thinks would cover the subject, to which he has evidently given considerable thought. Is there any objection to that suggestion?

Mr. FORTIER. Mr. Chairman, allow me to make a suggestion somewhat similar to yours, and that is that a committee, of which Dr. Mercau shall be a member, be appointed to consider the subject, and to report at a subsequent meeting of the irrigation subsection.

The motion was duly seconded and carried.

The CHAIRMAN. I believe, Prof. Fortier, you were chairman of that section, and I will ask you to appoint the other members of that committee.

Is there any further discussion with reference to these papers or these subjects?

Mr. FORTIER. Mr. Chairman, I would like to hear some discussion of a few points in Mr. Newell's paper. I refer in particular to the statement that from 20 to 25 per cent of the irrigated lands of the West are ruined by seepage and the attendant ills, or by an overdose of water. I am not sure that anyone here is in a position to either refute or corroborate that statement, since no census has ever been taken, to my knowledge, of the amount of lands actually damaged by the waste of water from irrigated lands and from irrigation ditches. But the statement strikes me as being rather too large. I was not sure whether Mr. Newell included all of the reclamation works or only those under the Reclamation Service; but if his statement was general and intended to cover the entire irrigated area, which to-day amounts to 15,500,000 acres all told, then I am inclined to think that from 20 to 25 per cent of that area is not ruined in that way.

In the State of Nevada there is comparatively little land ruined in that way, simply because the rainfall is so light, being only about 7 inches, and the amount of available water so scarce that I place the percentage at a very low figure in Nevada. The same is true of Wyoming. I am inclined to think the percentage of land ruined in

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Montana could not be over 3 or 4 per cent. Coming to California, according to the reports our office prepared through Mr. Adams, of California, during the past year or so, California irrigates about 3,500,000 acres. While it is true that in certain parts a lot of land has been damaged in this way, yet I think the total percentage, even in California, would not be over 7, or perhaps 10, per cent at most.

Colorado is the next leading State in regard to irrigation, being about the same as California. In Colorado it is also true there are large areas in the Grand River Valley and Arkansas Valley and in the northern part of the State that are affected injuriously in this way; but even in Colorado the percentage would not be, I think, as high as 20 or 25 per cent. I would like to hear an expression of opinion, Mr. Chairman, on that point, if possible.

The CHAIRMAN. Gentlemen, you have heard the remarks of Prof. Fortier. Is there anyone here who has made any observation on the subject and who can give us any light?

Mr. FULLER. Mr. Chairman, in my paper which I presented yesterday I gave the area of water-logged land under irrigation projects in some five or six of the States. I think they included some of the largest ones. While in some sections there were places—for instance, in Texas—where 50 per cent was water-logged and required drainage, and in Colorado there was something over 250,000 acres requiring drainage, notwithstanding that, if you took that total water-logged area and compared it with the total area irrigated, I think that about 10 per cent probably would be a very fair estimate. I do not believe it would reach 25 per cent.

Mr. FORTIER. I think, according to your figures given in your paper, it is about 8 per cent.

Mr. FULLER. That is probably correct. It seems to me that is a very serious matter and, considering the rate at which the area is becoming water-logged through overuse and misuse of water, in a very few years we are going to have to face a problem that will be a serious one—a problem that is going to be very serious. That is my opinion. I would like to have an expression on that point as to whether the subject is one that should give us concern at this time.

The CHAIRMAN. Another point in connection with that is this: Are not drainage, tiling, and corrective measures of that kind reclaiming water-logged areas to a considerable extent, so that we do have some compensatory feature in it after all? I know that in northern Utah they are draining quite a considerable area, something like, as I recall it, 20,000 acres, that have for 10 or more years been quite without value on account of lack of drainage and being water-logged. Some of those lands that I observed this fall have raised their first crop of wheat that has been put on them for a long time. Is there anyone else who has made observations on that subject?

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Mr. FULLER. Mr. Chairman, is it not the case, when drainage systems have been installed, that to remedy the evil it is necessary to continue the operation of the drainage system indefinitely? That is, it is not a temporary procedure, but must be run hand in hand with the irrigation system?

The CHAIRMAN. Oh, yes.

Mr. FULLER. Then, to that burden of irrigation must be added the burden of drainage. There is this possibility in connection with drainage: I have in mind one particular section in Arizona, where there are some 14,000 acres out of 20,000 acres that have been irrigated for the past 20 years, which are now water-logged and for which a drainage system is being put in. I remember some 10 years ago, in some engineering work I did in that section, the water plane was 20 feet below the surface. It is now within 3 feet of the surface. I had in mind at that time the use of that recovered water, mixed with canal water, on land lying lower, and it was very possible and feasible, since there was a large area that could be irrigated, and in that way possibly compensate for the cost of the drainage, but the alkali was so extensive that the project was not feasible at this time. But as the alkali becomes shallow—you understand, a soil may be alkaline and may be made so by the rising water plane—in time, as the irrigation water is applied, the percentage of alkali may be reduced greatly and the water may be relatively pure, so that subsequently that water may be used for the irrigation of these lower lying lands. So it may not be as serious matter as we think if we take into account the possibility of using that recovered surface water for the irrigation of other lands at a higher or lower elevation. Of course, in the first case it would have to be pumped up.

Mr. FORTIER. Mr. Chairman, I can confirm the last speaker's statement, that irrigation can be practiced without water-logging. I do not mean to be understood to say that we can apply water to porous soil and prevent waste. There is bound to be waste, but we can do very much in preventing this, both in the seepage loss in transmission and in the evaporation feature as well as in the preparation of the land and the application of the water. To-day I am not nearly so much alarmed over the injurious effect of water-logging on western land as I was 12 or 15 years ago. I believe that the matter is under control. I do not wish to receive any credit whatever for that. I think the credit belongs to my colleague, Mr. Elliott, who worked for years in correcting that abuse and in striving to outline the proper methods of draining irrigated lands.

Mr. WILLIAMS. Mr. Chairman, I think there is another interesting relation between drainage and irrigation that is developed more in the eastern half of the United States. I think they go more closely, hand in hand, as you approach more humid climatic conditions. For

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instance, in the Sacramento Valley, which is practically humid half the year, the drainage is more important with respect to the irrigated areas than it is in the more arid regions. In fact, drainage was developed for wheat growers before irrigation was taken up, and since irrigation has gone in, the water level has come up, the same as Mr. Fuller cited, within a very short distance of the surface, so the drainage problem has increased. As you come east into the humid regions I have found in my experience that the tile-drained lands and the swamp lands which have been drained are not immune from the effects of a drouth, and that instead of irrigation following drainage, we have drainage following irrigation. As an example of this, some of the Dismal Swamp has been drained. Farmers are now taking up the question of irrigating that very same land. There is trouble in the Everglades in Florida. As the drainage question is being solved, the irrigation problem comes in, and will probably be more difficult than the drainage problem in the first instance.

The CHAIRMAN. I think that last statement is especially true with respect to the Everglades. The danger is there, that if you do not follow your drainage by irrigation, your land is liable to burn up. Are there any further remarks on the subject?

Mr. FULLER. Mr. Chairman, there is one question I should like to ask in connection with Mr. Reed's paper. Prof. Fortier stated the cost of reclamation varied from $28 to $32 per acre.

Mr. FORTIER. I did not read the whole paper. I think that was a low average. Those are figures I found in the first column, but I think the others are high.

Mr. FULLER. I was wondering why it was possible to reclaim land so cheaply under the Indian Service when we know the general cost is from $50 to $60 in private projects. It may be that the fact that the Indian Department does not have to consider large impounding or diversion works explains it. I know some of them comprise merely pumping projects in attempting to utilize the supply.

The CHAIRMAN. It has been my observation that the Indian Service irrigation projects are likely to be selected with a little more caution and do not indicate quite as much plunging into unknown realms as the irrigation projects constructed elsewhere. The guardianship imposed by the Government seems to be especially effectual in that particular point.

Mr. FORTIER. Mr. Chairman, I desire to read now from Mr. Newell's abstract, in the closing paragraph of which he states that "the crucial point in irrigation and drainage is not so much these matters of engineering as it is the more difficult problem of the use of the reclaimed land," etc. I think we have there a very vital question, which I would like to hear discussed.

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The CHAIRMAN. We would all be delighted to hear it discussed, I am sure. Will some one please volunteer? I think the truth of that suggestion has been brought home to so many people, especially some that have invested large amounts of money in irrigation projects, that there ought to be a very full and free discussion of it. I am sure there would be if we could only bring it up among a group of investment bankers or something of that kind. If there is no discussion on that point——

Mr. FULLER (interrupting). If there is not going to be any discussion I want to start one. This is a very serious question, to my way of thinking. We have expended millions of dollars in irrigation works throughout the West. It has been assumed many times that all that was necessary to do was to create the irrigation works and supply the water to the land, and the rest of it would be an easy matter; that the people in the East were looking for homes and wanted to get back to the soil. That is true to a large extent. There are a great many people who would like to get back to the soil if they knew something about it. It was brought to my attention several years ago when a certain irrigation project was contemplated. The promoter spent some time at a certain factory in Milwaukee, and at the luncheon hour was asked to discuss irrigation possibilities or practices in the West. Being a very interesting talker it seemed he had impressed them with the wonderful possibilities under these irrigation projects in the West, so that the entire time was occupied in this discussion. He told me that in the afternoon as he walked through the factory he had dozens and dozens of inquiries from workmen who wanted his name, wanted to know where they could reach him so they could learn more about the possibilities of getting back to the soil in the West.

It impressed me that that is the kind of colonization work it would be necessary to do; that is, to go among the people and impress them with the possibilities, and in that way take the people to the land. On the other hand, it has been said that there was a possibility of getting a class of people on our western areas that were not suitable and were not farmers and that would possibly make a failure of it. It has been my observation that if you take a business man from the East and put him out on an irrigated area and instruct him properly in the use of water and only keep him away from the old pioneer, he will be all right, because the old pioneer has adopted the practice that has been forced upon him, due to an unregulated stream flow. We all know that during times when we were compelled to use unregulated stream flows we were compelled to conserve moisture in the soil when it was plen-

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tiful. If we can keep him away from that influence and instruct him properly he will make a greater success as an irrigation farmer than the majority of the old farmers who have practiced it for years. I have seen that worked out in California, Arizona, Colorado, and in other sections. It requires business methods and business applications, and if that principle is followed there is no question as to the ultimate success of it.

I believe, therefore, that if a few business people who have had to work hard and have not been able to accumulate anything for a rainy day can be gotten out there they will make a success of it. I think then if we can eliminate the colonization bureau scheme whereby various irrigation projects employ certain agencies to advertise the lands and the possibilities, and if we can secure the confidence of the eastern people—not the investor necessarily, but the man of ordinary means—we will then have secured a greatly needed influx of desirable people for our western lands.

I do not know that many of you are acquainted with the condition that does exist under these reclamation projects, both private and Government, in the Western States. There are vast areas under all of them that are lying idle to-day, for which there is water available, and yet which are not used because of the lack of people. The result of that is that the overhead expense must go on just the same, and the few people who now colonize the land must bear that overhead expense. I speak more particularly of private projects when I say that. It is necessary that some scheme be adopted whereby we can people the western lands. I have always felt that is a duty of the Federal Government. I think the Federal Government should establish a colonization bureau upon a very broad scale, and should, by illustrated stereopticon lectures, present the possibilities to the business men in the East.

Mr. SUTTON. Mr. Chairman, I think every irrigation engineer has been confronted with problems like that for the last 10 years, possibly. The suggestion of the gentleman from Argentina worked in very well with all this other discussion. I did not quite understand whether his suggestion was that a resolution should be passed upon the matter of irrigation legislation or whether he wished to emphasize particularly the question of application of the laws already existing.

I think the question of the utilization of water power in connection with irrigation projects, the regulation of the use of water, and the settlement of the lands are all based on the same problem, which must be considered as one problem and coordinated. In fact, the problem that confronts the irrigation engineer to-day is more an economical one and not a technical or technological problem at all. The irrigation engineer has waited for years and looked to the

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prophets or political economists for some help. I do not think he is getting much, not because the political economist could not help if he would, but because he is not interested in that phase. He is more interested in the industrial problem. Irrigation land is never marginal land in that sense. It must pay interest on the capital invested in it in such way that the capital is sunk in the land. So, if the irrigation works are once built and it is a question of colonization, the investment banker who has his money in it can not reorganize the land next year to meet the popular demand more satisfactorily. It is gone for all time if it is not successful. Since that is true, the land can not be settled by the marginal farmer. In order to have successful irrigation you have to have high-grade farmers, and no amount of propaganda, advertising and pictures, excursions and colonization agencies is going to do us any good, unless—as these gentlemen have all said, I think, in various ways—it is recognized as a fundamental part of the governmental policy, and unless the Government recognizes that the ultimate test of a public policy is the type of man upon the land, not that the ultimate test of public policy is the construction of irrigation works or the building of roads or the raising of crops, but that it is the type of man which all of these things coordinated represent—the laws governing the use of water, the coordination of the irrigator on the upper lands with the uses of water on the lower lands in drainage, and with the use of all that water and all those resources to produce power to pump the water from the lower land back upon the higher ones or upon other lands.

I think those are questions which must be embodied in a water policy through cooperation of all the specialists who have devoted their time to one or more phases of the subject in the evolution of the whole problem.

The CHAIRMAN. Is there any further discussion of these papers?

Mr. FULLER. I should like to ask the gentleman who just spoke (Mr. Sutton) this question: Do I understand that we can not depend on that class of people for colonization—that is, the business class, those who have made more or less of a success in the ordinary walks of life, and yet, owing to adverse circumstances, have been unable to accumulate? That is the class of people I would attempt to reach. I would not attempt to reach the shiftless or worthless fellows who have made a failure at various undertakings.

Mr. SUTTON. I think these men have already, so far as they are concerned, been eliminated from that consideration. They have been successful and have the means of becoming more so. As a matter of fact these men look forward to the future in a different way, and they represent a very small percentage of our total population. Of course a census has never been taken, but we have a



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general indication of this fact. There are 100,000,000 people in the United States and only 2,000,000 automobiles. That is to say, for 2,000,000 people only in the United States an automobile is beyond a margin of utility. They can afford to buy automobiles. Therefore we can say that 2 per cent of the population is in condition to consider the future in connection with your proposition. But they would consider it by looking forward to convert themselves into gentlemen farmers, so called, not to go out into the arid districts out West.

But I do not criticize your proposition. I think it is fundamentally right, but you do recognize the truth of my proposition when I say you must look to people who are better prepared in experience and in the qualities that come from a habit of success. My own experience has been among people more or less of the type that Mr. Reed's paper discussed—people who can not be compared, who are satisfied now with 10 or 12 acres of land and willing to work all of their lives in order to acquire it and are willing to pay as much as $700 an acre for it, and yet who are not high-grade farmers. There, I think, is a very clear proof of the fact of the success which awaits irrigation yet. You could not in this country take an Indian off the reservation—a man willing to work on the railroad for $1.50 a day—and get him to pay $700 an acre for irrigated land, and yet in some parts of South America they do that. They are satisfied with only 10 or 12 acres and are willing to work their lives to get it or are willing or are forced to pay the rent which would be equal to that capital value of $700 per acre, multiplied by the current rate of interest on farm land during their whole lives for that land.

I think you are perfectly right when you look to high-grade people for irrigated lands. The general problem must be recognized by the Government as one of agricultural education, demonstration, and agricultural experiments, not in some center removed from agricultural districts, but right among the people themselves, and especially among those people whose center of production and consumption is away below the level of people in more populous communities.

The CHAIRMAN. If there is no further discussion upon these subjects, the meeting will stand adjourned.

Thereupon, at 4.30 o'clock, the joint meeting adjourned.

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## JOINT SESSION OF SUBSECTIONS 2, 5, AND 7 OF SECTION III.

RALEIGH HOTEL,
*Thursday afternoon, December 30, 1915.*

Chairman, RAYMOND A. PEARSON.

The session was called to order at 2.30 o'clock by the chairman.

The CHAIRMAN. Our first paper this afternoon will be upon "The function of live stock in agriculture," by Mr. George M. Rommel, of the United States Department of Agriculture, the chairman of Section III.

Mr. ROMMEL. I have prepared a short paper on a subject which sounds very self-evident to anyone who knows anything about animal husbandry, but it seems timely, particularly on this occasion, to give a résumé of the facts which are generally regarded as fundamental on the relationship between live stock and agriculture; to epitomize, in a way, these facts without intending to put forth anything that is startlingly new.

### THE FUNCTION OF LIVE STOCK IN AGRICULTURE.

By GEORGE M. ROMMEL,

*Chief, Animal Husbandry Division, Bureau of Animal Industry, United States Department of Agriculture.*

The animal industry is the most important branch of the agriculture of the United States. With a total value so great that one can not visualize it, it has an annual production of $2,750,000,000, which is greater than the cereal output in an ordinary year. It is three times as valuable as the annual cotton production or the hay crop, and the latter largely depends on the animal industry for its value.

You have all read Ingalls's brilliant apostrophe of grass, and recall how he said that "Should its harvest fail for a single year, famine would depopulate the world." Poetic and beautiful as that sentiment is, it is economically and hygienically sound.

Some form of forage is essential, fundamentally, to the maintenance of animals; the animal industry is essential to the well-being of a prosperous and permanent agriculture, and a diet in which animal products form a part is essential to human health.

The function of live stock in agriculture rests on seven main points.



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### THE MAINTENANCE OF SOIL FERTILITY.

The first and most important is the maintenance of soil fertility. An elaborate development of this point is not possible in this place. I can, however, illustrate it by citing the report of the Thirteenth United States Census on Agriculture. Of the 10 States which lead in the value of animals sold and slaughtered on farms, all but two, Oklahoma and Kentucky, are among the first 10 States in the value of all products. The two States which appear in their places are New York and Minnesota. New York holds a place among the first 10 States in all products by reason of leading in dairy production and hay and forage, and Minnesota wins her place by reason of her prominence in dairying and cereals. Of the 10 leading cotton States, only 2, Oklahoma and Texas, are also among the first 10 States in value of animals sold and slaughtered, and only Texas is among the first 10 in value of all products.

Taking St. Louis as the center, describe a circle with a radius of 500 miles, and we include within it part or all of the 10 leading States in animal production, part or all of 9 of the 10 leading States in value of all products, and part or all of 9 of the 10 leading States in cereal production.

Surveys covering a period of years by the Iowa State College show that the live-stock farms of the State produce much larger grain and hay yields per acre than do the strictly grain-producing farms. To maintain soil fertility humus is necessary. It can be obtained from two sources—green crops plowed under or barnyard manure. In view of the fact that a large proportion of the fertilizing value of forage and feed appears in the manure it is more economical to feed rather than to plow under without feeding. Therefore the most economical and practical source of humus is stable manure. No fertilizer equals it in completeness and lasting qualities. The farmer who has an abundant supply of this fertilizer and who balances it with phosphates, and supplements it with nitrates for forcing crops, need never fear the approach of decreasing soil fertility.

### THE MANUFACTURING FUNCTION.

The second function of live stock is that it enables the farmer to carry out an important manufacturing process. The farmer thus completes a manufacturing cycle. He takes the lean, unfinished cattle and his grain and forage, all raw products, and by the application of intelligent supervision, skillful labor, and adequate equipment converts them into finished beef, or mutton, pork, or dairy products. This is the process familiarly known as "marketing the farm products on four legs," and is much to be preferred to marketing on four wheels. With intelligent management the farmer thus obtains in terms of meat and dairy products a much larger profit than he could possibly derive by selling his crops in the raw state. This doubtless accounts largely for the fact that in most farming sections the most prosperous farmers are those who pay a large amount of attention to live stock. It is of the greatest importance, especially in those sections of the country which are just beginning to diversify their agriculture. In the Great Plains region and on most of the Federal reclamation projects it is, after the question of water for the crops, the most vital problem which farmers have to solve.

In the region of settled farms, where cereal production leads all other forms of agricultural production, farmers have a difficult problem to adjust the necessity for live-stock raising with the high price of grain. We therefore see a second phase of this function in the use of live stock to convert into salable products, crops which for one reason or another have a low market

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value. At the present time the farmers of the northern part of the corn belt are at a loss to know what to do with the soft corn which frost left on their hands in early October. It is not marketable, and the only value it has is as feed. Not knowing just how to dispose of it in this manner, farmers are sending immature pigs to markets in large numbers and are curtailing their cattle-feeding operations. The soft-corn problem, however, is an occurrence of only occasional importance. The constant problem of the farmer on high-priced land is how to keep his live stock economically. He can not afford to feed grain with a lavish hand. He must measure it by weight, not by volume. He must feed it at the time and in the manner to obtain from each bushel the maximum of gain in weight, of milk produced, or of work done. To the fullest extent possible he must utilize unsalable roughage. The corn-stalks go into the silo or into the shock as cut fodder. The straw and coarse hay is utilized to the last calorie of energy value to supply the maintenance requirements. Crops that animals such as hogs and sheep can harvest will be utilized.

### MOTIVE POWER.

The third function of live stock in agriculture is to supply most of the motive power used on the farm. From an engineering standpoint this is the most important single problem with which the farmer has to deal. In the aggregate our farmers have every year to determine the efficient application of about 25,000,000 horsepower—an amount equal to about half the total available water power in the entire country, excluding Alaska. The proper hitches to use, the adjustment of harness, whiffle-trees, etc., are problems which, for successful solution, call for the correct application of some of the fundamental laws of physics. How to feed his work animals to get maximum efficiency when at hard work, how to maintain them when idle, without serious deterioration, are problems just as important and just as difficult as those of the engineer in charge of the furnaces of a manufacturing establishment.

What will be the effect of mechanical power on the future use of horses on the farm can not be predicted. Slowly but surely the auto truck is driving dray horses off our city streets. Already the cheap automobiles have effectually put the driving horses off our country roads. The farm demand has been for several years the mainstay of our horse market, and the tremendous exports of the past 15 months have saved us from a period of great depression of horse prices. If the farm demand is to continue the chief output of our horse market, as it no doubt will do, the question of the suitable horse for this market is highly important. The great ton drafter has been the aim of the farmer breeder of the corn belt. That has been the horse which the city market demanded when in its prime. These horses are most valuable for moving heavy loads. With the increase in the weight and draft of farm machinery, they have been also most useful for farm work, especially on heavy soils. The position of these horses on the farm is being attacked by the small tractor, and the tractor manufacturers believe that they can in time displace them. It has been observed time and again, however, that for each displacement of the horse has come an enlargement of industry which calls for further uses for horse-drawn apparatus. The question, therefore, is what type of horse will the farmers of the future need. This question can only be answered by speculation. Except for the heaviest farm work, such as plowing and hauling, the ton horse is not so suitable a farm work animal as a smaller, more active one. With the disappearance of the city demand for the heavy drafter, the farm demand will be met by breeding a lighter, more active animal. Therefore we will probably

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witness during the next 25 years a return in the Percheron, for example, to the type of the French "diligence" horse, which was the early Percheron type, and an increase in the size and weight of our native breeds of horses—the Standardbred, the Saddle Horse, and the Morgan.

### THE PRINCIPAL SOURCE OF INCOME.

Live stock as the "money crop" of the farm is a specialty business in diversified farming regions. In dairy districts it is, of course, the main activity and every phase of farm management is bent toward that end. Where farming has been long established, however, and the principal function of live stock feeding is to maintain soil fertility, those farms on which the live stock are the main source of income will be breeding centers for pure-bred animals. Only the most skilled animal husbandman can make a success of this business, and of those who engage in it successfully only the occasional man becomes really eminent, just as in any other profession. The great live stock ranges pass with the approach of the homesteader or are limited to those areas unsuitable for crop production. The large feeding stations in turn disappear with the increase in the price of land, and the Nation's supply of live stock is drawn from production in small units, which in the aggregate make a total larger than was possible under more extensive conditions.

### LIVE STOCK INCREASES THE INTEREST IN AND THE ATTRACTIVENESS OF FARM LIFE.

The fifth function of live stock is to increase the interest in and the attractiveness of farm life. The problem of how to develop our agriculture by using for that purpose the best of the human life which has been developed on our farms is being attacked to-day as never before. The boys and girls which are born on the farm and which have behind them the inheritance of generations of sturdy physique, clear thinking, and clean morals which come from life on the soil and in the fresh air are the most valuable asset of the Republic. How to encourage these young people to make farming their vocation in life transcends in importance all other problems of our future agricultural development. The great Federal agricultural extension act has for its purpose bringing direct to farmers the fruits of the past 30 years of research in agriculture, but this act will fail of its purpose if its operations stop with the training of the adult farmer. In a generation the adults are gone. Their places must be taken by their own sons and daughters. Therefore we have the corn clubs, the canning clubs, potato clubs, poultry clubs, calf clubs, and pig clubs, all organized among children of both sexes of school age. To me this movement promises more for the Nation than does the work with adults. Children are plastic, they adopt suggestions, they can learn. The adult too often has become fixed in habits of thought and action, and try as he may he too often lacks the adaptability of his children to grasp new ideas and methods.

The innate love of children for animals is one of the most potent forces which an agricultural extension worker has at his command, and when we encourage the development of this trait, and thereby teach the child the importance of live stock in agriculture, we do something of the most fundamental importance to the agricultural development of the Nation.

The organization of poultry clubs and pig clubs among boys and girls is one of the most important features of the club movement. They are found in many States in all sections. Probably most of the members are among the clubs organized by the Federal Department of Agriculture in cooperation with the

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State agricultural colleges. To date there are about 5,000 boys and girls in the poultry clubs in 6 States, and 10,000 in the pig clubs in 13 States.

This movement was started as an outgrowth of the organization of canning clubs among girls and corn clubs among boys. It was found impossible, however, to keep the boys out of the poultry clubs or the girls out of the pig clubs. Therefore no discrimination is made as to sex.

The plan of the Government is, briefly, as follows: On application from the State the Federal department stations at the State agricultural college a specialist whose entire time is devoted to the direction of the club organization. At first this agent selects certain counties in which to work and for the first year or two supervises most of the work himself. His aim, however, is to train the county agents and school teachers so that in time they can take full charge of the work, leaving the State agent's time for new work in other sections. The schools are a most fertile field for the organization of this work.

Each member of a poultry or pig club is required to hatch a setting of eggs or raise and fatten a pig and render regular reports of his work. At the end of the year the members usually have an opportunity to compare the results of their efforts by exhibition at the county fairs or other places, and the winning animals at these exhibitions go up to the State fair for further competition.

This work has been in progress since 1910, and since 1912 the Federal Department of Agriculture has been engaged in it. Already the exhibition of pigs and poultry from the clubs has become a prominent feature of some of the State fairs, especially in the South. Many of the members of the earlier years are now bona fide breeders, and many a boy is paying his way through college by the earnings from the animals in which he became interested as a club member.

### METHOD, SYSTEM, AND BUSINESS ORGANIZATION.

The sixth function of live stock in agriculture is to improve the method, system, and business organization of the farm. The farm on which live stock are successfully raised must be managed in a methodical, systematic, business-like, and sanitary manner. Farming is first of all a business operation, and no kind of farming calls for more business sense than live-stock farming. A grain farmer does not suffer seriously if his cultivating or harvesting is delayed a few hours, but the stock must be fed promptly, rain or shine. Therefore the efficiency of labor assumes great importance. If the live stock is a herd of pure-bred animals accurate records are absolutely necessary and clerical ability of a high order is required.

The importance of sanitation on the live-stock farm is fundamental. The live-stock farmer need not be a trained veterinarian (the more he knows of veterinary science the better), but he must be by instinct a sanitarian. He must recognize clearly the difference between things that merely appear to be clean and those which are actually, bacteriologically clean. I shall not go into detail on this subject of sanitation, as it will be treated more competently by other members of this Congress. However, I can not refrain from calling attention to some of the experiences of the Department of Agriculture in the means of communication of contagious diseases of animals. In the great majority of known cases human carelessness has been the most fruitful cause of the spread of contagion. In at least one county in which the department has carried on work on the control of hog cholera, it was found that visits to neighbors' herds was the most common known way in which the disease was spread. We all know how prevalent is the custom in some sections of dragging dead animals

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out to a field without burial. Birds and dogs devour the carcass, and if death was caused by a contagious disease spread it over a wide area. Streams and irrigation canals are common sources of contagion. In every case of carelessness such as this the community suffers and every member of the community sooner or later pays his share of the cost.

With the increase of population and the cost of land, and the attendant cost of raising domestic animals sanitation assumes a constantly growing importance on the live-stock farm. However, it is not alone from the standpoint of direct profit that the farmer must pay strict attention to this matter. I will leave this subject with the simple reference to the fact that some of the most serious human diseases have their origin in the barnyard. Their prevalence not only affects the health of the families who come into immediate contact with them, but may spread with disastrous results to neighboring towns and villages.

The farmer needs education on the matter of sanitation. He needs to appreciate more fully his obligation, not only to his own family, but to the community. By realizing the fact that insanitary methods will diminish or entirely inhibit the profits from his animals he will in turn the better fulfill his obligation to safeguard the health of the community.

### THE REDUCTION OF LIVING EXPENSES AND IMPROVEMENT OF THE DIET.

The last function of live stock in agriculture to which I invite your attention is to reduce the family living expenses and introduce variety into the diet. It is a remarkable fact that a large number of farms produce only a small part of the food which is used by the family. The annual meat bill of the farmers of some of our Southern States, for example, is enormous. Their purchases are largely carried on credit, and the year's crop goes largely to meet the expenses incurred during its production. Debts accrue only to be replaced by accounts newly opened. That such a practice is wasteful and depressing is self-apparent. By the use of chickens and pigs, a cow, and a few sheep little capital is required to reduce in great measure a part of the annual money outlay of such farmers. This production of home-grown food can be made without limiting in the least the crop output of the farm. It simply requires planning and a little more careful management.

The value of live stock in agriculture has been greatly emphasized by the recent announcement of the United States Public Health Service that the cause of pellagra is a dietary deficiency due to the excessive use of carbohydrate foods. This dreadful disease has been spreading with alarming rapidity, and the determination of its cause is a triumph of medical research. To an animal husbandman it is of especial interest to note that among the means of prevention advised are to keep a cow and use more milk, butter, and cheese, to keep a flock of chickens and have fresh poultry and eggs, and to increase live-stock raising, so that meat may form a larger part of the diet.

### CONCLUSION.

I have endeavored to show how important live stock is to the development and permanence of agriculture. The function of live stock in agriculture for most, if not all, of the American Nations is fundamental. Soil fertility, the business success of the farmer, his happiness and contentment, and that of his children, the health of the community and the well-being of the farm family depend on the maintenance and proper management of as much live stock as the farm can economically support.

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The CHAIRMAN. I shall now announce the remaining papers of the program of this session:

The horse in rural industry and recreation, by Carl Warren Gay.

Relation between wool and mutton production in North and South American sheep industries, by F. R. Marshall.

Government control of grazing on the public lands, by Albert F. Potter.

Great central markets for live stock and meats, by Louis D. Hall.

Truck crop marketing on a large scale under cooperative principles, by N. P. Wescott.

Unless you wish otherwise, these papers will be first presented, with discussion to follow at the conclusion of the reading of the last paper.

## THE HORSE IN RURAL INDUSTRY AND RECREATION.

By CARL WARREN GAY,

*Professor of Animal Husbandry and Chairman of Animal Industry Group, Department of Agriculture, University of Minnesota.*

The subject under discussion is most comprehensively arranged under the following headings:

1. Horse breeding as a rural industry.
2. The part the horse plays in the conduct of the rural industry—farming.
3. The horse as a factor in the recreation of the rural population.
4. The horse as a factor in the sports of the city folk who take to the country for their recreation.

We shall take them up in this order and then, in conclusion, refer back to the first, which, to a certain extent, is contingent upon the other three.

### HORSE BREEDING AS A RURAL INDUSTRY.

The chief concern of horse breeders, present and prospective, is for the future of the industry. The motor, the tractor, and the war are common topics of conversation at the shows, the breed association meetings, and, in fact, wherever horse breeders assemble, each one expressing his opinion and seeking the views of others. Unfortunately, no one can do more than translate the handwriting on the wall, and all do not read these signs alike.

Naturally, horse breeders as a class desire to be optimistic, but they do not propose to launch their breeding operations until they are satisfied that their optimism is well founded. It is better to view the situation as a cool business proposition than with eyes blinded by sentiment or prejudice.

There seems to be ample justification for the belief that history repeats itself, hence we do well to look for a precedent covering the present situation. The horse is known to have been domesticated 1,715 years before Christ. Chariots, which are not recorded as having been drawn by any other than horses, are mentioned in Genesis xli, 43. Horses are specifically referred to in Genesis

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xlvii, 17. Furthermore, the most recent archæological investigations indicate the use of the horse in the Old Stone Age along with the dog and the reindeer. These facts do not bear directly upon the problem confronting us to-day, but there is no other instance in history where a creature or an institution that has been so intimately associated with man's weal and his woe, and played so important a part in the progress of civilization, has passed out of existence. Hence we can not but believe that the dream of the motor salesman brilliantly pictured on a motor supply concern's calendar, of a motor car crowding Old Dobbin to the brink of the precipice "Oblivion" and then pushing him over, is only an idle dream and will not come true in any material sense.

The present and future status of the horse must be determined before horse breeding as a rural industry can be passed upon. The chief contender with which horse breeders have to reckon is the motor—the truck in the city, the tractor in the field, and the passenger car. We review under the succeeding heading the competition of the motor tractor in the field; here we consider the motor truck on the country road and city street. It is possible to make a more definite comparison in this instance, as the motor truck has been more thoroughly proven than has the tractor as yet. That they are practical is attested by the increasing number that any casual observer will note. Astonishment is frequently expressed that the demand for work horses and the prices allowed for them should not reflect in the slightest degree the increasing number of trucks used. Exception must be taken to the past year, but that is fully accounted for by the general business depression that prevailed. Already the improvement in business conditions is felt in the horse markets. The logical inference from the continued demand for work horses in the face of an increasing patronage of the auto truck is that the trucks have supplemented rather than supplanted the work horse.

No one can deny that for some kinds of delivery service the motor is much more effective; in fact, it has to a considerable extent revolutionized delivery service and is indispensable. But, even if it should put the horse out of the delivery field, there is employment for as many horses as ever in construction work and other fields where the motor is impossible.

One serious drawback to the economic advantage of the motor truck or tractor over the horse is the steadily advancing price of gasoline. Its supply is, of course, limited, while the amount consumed is evidently unlimited, as the number of cars increase. Under the law of supply and demand it would appear that the price must continue to advance, to the end that an almost prohibitive figure will be reached.

Some well-informed optimists concerning the future of horse breeding lay great stress on the post-bellum demands for horses from Europe. Not only have foreign countries paid over $80,000,000 for nearly 500,000 American horses and mules and have contracted close up to if not in excess of the available supply, but we are advised to prepare for an unprecedented foreign order for both breeding stock and work horses to take part in the reconstruction period to follow the war. To such who take this view the future of horse breeding as a rural industry is unusually bright.

If we can thus convince ourselves that the horse will continue to be a factor in our industrial and economic welfare, we may settle down to a solution of the problem as to just what lines his use will follow and what modifications in types of the horses themselves will be necessary in order to meet the new demands that will be made upon them. In the three other divisions of this subject we shall expose in detail what these demands are or may be expected to be and what further assurance there is that horse breeding as an industry gives promise for the future.

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### THE HORSE IN RURAL INDUSTRY.

The first evidence of the horse being used in agriculture is on the Bayeux Tapestry in the eleventh century. Since an early time he has been the chief, though not exclusive, source of power on the farm. To what extent his services may be dispensed with in this motor time is the question horsemen are trying to answer. If the gains made by the tractor during the past season could be accepted as a fair criterion, the farm demand for horses in the future might be expected to be very much restricted. However, there are some side lights that should be thrown on the main issue before accurate deductions can be made. The motor people are waging their campaign by the most capable class of salesmen they can employ. The advent of the war turned loose, so to speak, on the farmers of this country and Canada the forces with which they had intended to sell practically the whole world. With such a restricted field in which to operate, their concerted effort has been exerted with telling effect. That may be taken as one of the reasons why so many tractors have been sold this year. Furthermore, tractors are in the experimental stage, and nearly every progressive farmer who believes he has use for them is trying one out. Whether or not the results of their experience will mean a continuation of sales on the present basis remains to be seen.

Thus far the testimony is conflicting. The Breeders' Gazette has been running for some months past, in its columns devoted to the horse, letters from farmers having had experience with tractors in all parts of this country and Canada. While the unfavorable reports are not unanimous the horse seems to have the better of the argument. We should recognize, of course, the nature of the publication and the greater likelihood of the horse's side being presented therein, but this does not detract from the force of the arguments favoring the horse.

Two leading Percheron breeders recently invested in tractors—one to cultivate his orchards, which seemed to him to be particularly a tractor's job, the other to test them out to his own satisfaction in order that he might draw his own conclusions concerning their influence on the horse industry. The first gentleman used a $2,000 tractor one season, when he took great pleasure in accepting $400 for it. The second admits that for a certain kind of work, of which he has considerable, he regards the tractor as a good investment, but he does not see how its use, which is bound to be limited, can materially affect the number of horses required on the farm. Another gentleman prominent in the engineering world and extensively engaged in the railway-supply business, justifies the breeding of draft horses in his own case on the ground that he knows he is producing "the most economical source of power that the world has seen." One reliable correspondent of the paper mentioned above summarizes the situation in western Canada, where conditions especially favor the use of tractors and they have been quite generally adopted, as having led up to a classification of farmers on the tractor basis by the banks. They recognize horse farmers and tractor farmers and find it necessary to discriminate against the latter class in the matter of credit. The best-informed man on horse-market affairs replied to the query, "What is the tractor going to do to horses?" "No more than it has already done; the tractor boom has spent its force."

A comparison of horsepower and tractor power should comprehend two things—efficiency and economy. Regarding the first, there seem good reasons to believe that for some kinds of work as fall plowing of heavy prairie soils in large fields, the tractors are more efficient, but the economy of using them is not so well established. Their first cost is large, as is the cost of maintenance and operation, the recent advance in the price of gasoline figuring conspicu-

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ously in this connection, while depreciation is proportionately great and much in excess of the depreciation on a similar investment in horses. They may even enhance in value while rendering maximum service if properly managed. Another season will, no doubt, afford more definite data, but to date there is no foundation for pessimism, in reviewing the horse versus the tractor. Consensus of opinion seems to be that, as in the case of the motor truck on the road, the tractor will supplement rather than substitute the horse in the rural industry. But in so doing it may modify the type of horse most in demand. It has been predicted repeatedly, that a smaller, more active, versatile horse will be required. We can not accept this as sounding the death knell of the heavy drafter, however. There will no doubt continue to be a call for all the high-class heavy horses that are bred, but it may be taken to mean that the premium that has been paid for weight, and weight alone, will hereafter go to the horse of better step and stamina even though weight be sacrificed to this end.

### THE HORSE AS A FACTOR IN THE RECREATION OF THE RURAL POPULATION.

Rural welfare is a recently developed field of sociology. Farmers are admonished to devote more time and thought to recreation and the joy of living. The writer has elsewhere referred to the country without a horse as being akin to a library without books. The matter-of-fact farmer has been inclined, in too many instances, to regard horses merely as helpmates in the rather hard lot to which they had both been cast, and to frown upon any horse that could not or would not work. There is satisfaction, if no recreation, in working a pair of good farm horses, but what broader avenues of pleasure lie before the farmer who does not begrudge the cost of keep of the horse which can not work, as he interprets the term, but offers a ride or drive for pleasure that is well worth his indulgence.

### THE HORSE AS A FACTOR IN THE SPORTS OF THE CITY FOLK WHO TAKE TO THE COUNTRY FOR THEIR RECREATION.

Many years before there is any record of horses having been generally used in the industries, rural or urban, they were taking a leading part in the sports and pastimes of the people. Racing, hunting, polo, and the gymkhana were all represented at any early period, and driving for pleasure developed great popularity as early as the construction of vehicles and roads would permit. It is the writer's personal opinion that the sporting horse—i. e., the other than work horse—is on the safest and soundest basis of any horse, but unfortunately the demand for him is not sufficient to sustain the industry on its present broad scope should the work horse be superseded by the motor.

The sporting horse has a hold on his patrons that defies competition. He is ridden or driven, not for the purpose of convenience or rapid transit, but for the comradeship and delightful sensation which only a horse can render. This fact is, seemingly, more accepted to-day than ever before, and riding and driving for pleasure is almost exclusively a rural recreation. The motor is largely responsible for the latter and incidentally for the former as well; that is, the common use of motors has made it unpleasant and even unsafe to ride or drive over city streets, forcing equestrians either into the parks, which are essentially bits of country within the city, or away into the country proper. On the other hand, rapid transit facilities afforded by the motor car have made it possible for many people to get into the country, there to enjoy a morning gallop or lively brush, who would otherwise be deprived of this

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participation in the most exhilarating form of rural recreation. Therefore the very agency which has crowded the horse into the country has favored his patronage there. Horseback riding, fox hunting, and polo are engaging more people than ever before, while racing and the horse show are apparently as popular as ever. We even hear rumors from time to time that the harness horse is coming back, and there is some evidence to support our hope. The Wissahickon drive in Fairmount Park, Philadelphia, has thus far been denied to motorists in spite of their repeated endeavors to have the restriction removed. When asked to show cause why this drive should be reserved for horses, the park guard stationed at the entrance to the drive replied that the number of "fine turnouts," as he designated them, on the drive the past season far exceeded those counted at any time during the past five years.

### CONCLUSION.

The results of the past 16 months are of the utmost significance to those who are now weighing in the balance horse breeding as a rural industry. The fact that horses have been available for export by the hundreds of thousands at the prices allowed army contractors does not indicate the depressing effect of abnormal business conditions nor forbode the future demand as much as it proves the accumulation of a huge surplus of unmarketable horses during seasons when the demand for some horses at high prices was strong. If horse buyers have been discriminating and the rejects numerous enough to accumulate this surplus in years past, producers should expect a much more particular demand in the years to come. One problem is not whether it will pay to produce horses in the future, but what class of horses can be produced at a profit.

## RELATION BETWEEN WOOL AND MUTTON PRODUCTION IN NORTH AND SOUTH AMERICAN SHEEP INDUSTRIES.

By F. R. MARSHALL,

*Bureau of Animal Industry, United States Department of Agriculture.*

The sheep has been the forerunner of settled populations in the greater part of the Western World. Its ability to thrive in areas producing but sparse vegetation and the high value of the easily transported fleece have made wool production paramount in all pioneer sheep husbandry.

It was upon the fleece of the stock from the Far East that the Spanish shepherds practiced their improving art in the thirteenth and fourteenth centuries. The earlier sheep husbandry of the United States was founded upon importations brought from Spain, though it is not often recognized that our western ranches, which now have more than half our sheep, established their flocks with blood of Spanish sheep that had come to them through Mexico. It was this same Spanish merino that furnished the first blood for improving native flocks or constituted the main foundation of the sheep husbandries of South America, Australasia, and South Africa. These are the countries that now furnish the bulk of what new wool is used in clothing the world's population.

The United States has for some years imported more than one-third of the wool used by her manufacturers. All the other countries mentioned export wools, but appear to have reached the limit of rapid increase in production.

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British South Africa is the only important wool-exporting country that has not shown a decrease from previous years' clips at some time since 1910. The best data obtainable from various countries indicate that the world's wool production has been practically stationary during the last six years. The only area from which a marked increase of exports is possible is in Asia, and there is small prospect of important changes there for many years. If the world's wool supply is to keep pace with consumption the present producing countries must increase their production, and there are many reasons why this is not likely to occur in the near future.

Recent years' meat prices have increased slaughtering so largely in all countries as to prevent increase in numbers of sheep. Of course, heavy slaughtering adds to the supply of pulled wools, but the amount of wool procured from immature animals entering the meat trade is greatly lessened, and particularly so when the parent stock is chosen with small regard for fleece and sometimes yield less than half the amount of wool taken from the nonmutton stock which was supplanted. The new era of higher meat values and railway construction has brought stock shipments from outlying lands that previously could send only wool, and that by ox-drawn freight wagons. Ocean refrigeration space now carries meat 8,000 miles for 1 cent per pound, and the pastoralist of Australia and the estanciero of Argentina have ready access to the markets of European cities with their surplus stock. Flocks of many generations of breeding for wool have been dissipated in a few generations of breeding for mutton.

Breeding policies of sheep raisers of both continents have radically changed in the past 15 years and are still far from settled in the grazing areas that produce most of the wool and mutton. Wool-trade conditions now at hand are certain to bring another change in the producer's relative regard for fleece and carcass. The effect of these changes upon the future sheep industry of closely tilled land must be considered apart from that of lands limited to chiefly grazing use.

### SHEEP HUSBANDRY ON FARMED LANDS.

While the wool sheep has been the pioneer of agricultural settlement, the mutton sheep is the most economical of animals for conditions of intensive stock farming. The sheep industry of England supports this claim. The cow may precede the sheep in the alfalfa fields of Argentina, as she has done in the Mississippi Valley, but quick returns, rate of increase, and economy of labor are sure to bring later consideration of sheep raising. The older parts of the United States are now beginning to turn to raising of sheep, after an interruption of their natural agricultural evolution by the influx of supplies from the lands of the Mountain States, where production costs were relatively lower even 10 years ago. Under these conditions wool may continue to be regarded as secondary to mutton, but it will by no means be an incidental production.

Sheep stand alone in their ability to yield a quickly made marketable article from a maximum of forages. In a single season they can harvest and economically use two immature crops from the same land that ordinarily produces but one seed crop. By manufacturing the plants into meat and wool before they make their greatest draft upon the fertilizing elements of the soil and by returning thereto the greater part of those elements, the forage-raised sheep are invaluable as conservers of soil fertility and indispensable occupants of land deteriorated or in danger of deterioration by grain raising.

It is the peculiar province of the Americas to bring science to assist in productive industry. Chemistry and physiology have made animal husbandmen

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more efficient in directing the uses and combination of feed stuffs. While the nutrition of the body has been and is being most fully studied, the nutrition and the growth of the animal fiber that is so largely used to clothe our bodies has been left practically uninvestigated. There is ample room and urgent need for biological investigations of inheritance of wool characters. No other animal characters are apparently so radically and seriously affected by environmental factors as are those of the fleece. A scientific understanding of these things would almost certainly lead to a useful measure of practical control in producing such qualities as special strength, color, and softness, which now arise from unexplained natural factors and are selected by manufacturers from the shipments of varied districts of many countries.

Scientific determination of the limits and control of rate of increase would be of immense service to the sheep industry, not only by rendering possible desired yields of lambs, but in conserving the lives of a large percentage of lambs born to soon die through lack of vigor that might have been afforded in the selection and environment of the parents. The intensive sheep husbandry of the future must be based upon plans which provide for conserving health and vitality by avoiding infestation from the widely distributed natural parasites particularly troublesome to sheep. While some localities seem to be free from parasitic troubles in sheep, it is quite certain that this handicap exists and constitutes a serious menace wherever sheep are closely pastured upon lands having even moderate moisture. The scientific work already done in studying the life history of sheep parasites is one of the most valuable aids rendered by science to animal husbandry. Its value will be more appreciated as farm flocks become larger and more numerous. It should be continued and extended for all districts of all stock-raising countries.

Along lines such as those indicated there is unlimited opportunity for investigations requiring the best scientific training and which are sure to be of greatest service to both rural and city populations.

### SHEEP HUSBANDRY ON ARID LANDS.

Despite any possible effect upon prices through increased supplies of wool or mutton from agricultural lands, large areas of arid lands will continue to engage largely in sheep raising because of being limited to utilization of natural vegetation. The sheep thrives in conditions impossible for cattle, and will indefinitely continue to yield the chief marketable products from millions of acres in North and South America. Nearly one-third of the area of the United States is unfitted to the production of crops suitable for human food. While live stock is well distributed over this area, it supports only one-fourth of the country's total number of farm animals, the balance being reared on lands which also yield large quantities of crops entering directly into commerce. Portions of Argentina, Uruguay, and Chile have arid areas similarly restricted as to character of possible output. The development in these areas of a sheep industry of fixed character is a question that is scientifically interesting, and economically most important.

Much depends upon methods of controlling grazing to conserve the native vegetation, but a still more difficult, though perhaps not more immediate problem, is the preservation of characteristics of animals that are native or that became practically such through many generations under conditions very little altered from those imposed by nature. The fleece, habits, and instincts of the Spanish merino of nomadic ancestry made that animal most valuable so long as wool was the main object. More recent considerations of carcass, how-

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ever, have brought a sucession of admixtures or crosses having the blood of the heavily fleshed and artificially reared British breeds. There appears to have been too little thought on both continents as to the final outcome of the kind of breeding that followed the demands of the meat trade.

The objection to the progressive increase of the blood of the coarser wooled sheep at the expense of the merino blood has been that the animal so bred shows a serious lack of the adaptability to the kind of life rendered imperative by the natural conditions which it is impractical to materially modify. This trouble has been of lesser importance where the sheep were gradually being displaced by other stock or where the feed supply has been rendered more abundant, as in the Province of Buenos Aires.

Owners of flocks in arid sections of the United States have found a serious difficulty in the mixed blood of their flocks resulting from crossings made to improve the carcass qualities. I am informed that in the drier Provinces of the Argentine there has been a similar experience. It is possible to meet the situation by continuing a portion of the flock with females having only merino blood. These can be used to produce the first-cross ewes, which are generally more uniform and satisfactory than later crosses. Such a plan is most difficult and expensive in operation. It demands too many divisions of the stock kept and the maintenance of too great a variety of breeds of stud sires. It merits the further objection of not permitting that continuous advance toward a higher standard of perfection which is most remunerative and is in itself a real reward to the desire for accomplishment that assures permanency in rural affairs.

The fact of the matter is that in the areas referred to there exists for the first time a real need for a peculiar type of animal not previously called for and therefore not previously produced. In all of the sheep husbandry of North and South America, until a few years ago, we have been able to draw upon Europe for well established breeds of animals adapted to our needs. But we turn in vain to Europe and to our own past accomplishments for a type of sheep to suit the present and future needs of the animal husbandry of the less fertile lands. The idea of a continual use of the older and existing types in such a way as to adjust the proportions of blood to furnish the kind of animal required is unsound in principle and unprofitable in practice. In the course of time we will undoubtedly come to a more general agreement as to the relative importance of fleece and form in sheep husbandry on these lands, and then proceed to produce a fixed type of the animal needed as was done by the horse and swine breeders of the United States. Experiments in this connection were inaugurated eight years ago by the Bureau of Animal Industry of the United States Department of Agriculture. It is not improbable that we have been forestalled in the undertaking by the New Zealand breeders, and that the trial importations of Corriedales that have gone into Tierra del Fuego and Wyoming will at least greatly hasten the completion of the undertaking.

### EFFECT OF SCARCITY OF FINE WOOLS.

Up to the present time commercial supplies of fine merino wools have come nearly altogether from parts of the world not yet evolved from the initial stages of agriculture, and having economic conditions that allow the rearing of sheep solely for wool production. With the exception of South Africa the main wool producing countries are turning to the raising of mutton sheep, the wool of which, while valuable for serviceable clothing, is not suited to the manufacturing of many classes of widely used fabrics.

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Manufacturers refer to all wools other than merinos as "cross-breds." Within the past 30 years New Zealand, that now furnishes 7 per cent of the world's wool, has changed from 90 per cent merino to less than 10 per cent merino and over 90 per cent cross-bred wool. Australia now exports 22 per cent of the world's annual yield, and has been the source of most of the fancier merino wools. In that country the changes toward raising cross-breds and less merinos is very marked. Competent authorities believe that inside of 10 years the Australian clip will contain less than one-half of merino wool. Argentina contributes 9 per cent of the world's clip, and now ships less than 25 per cent merino wool. The United States' annual clip equals 10 per cent of the world's supply and contains at least 75 per cent of cross-breds or non-merino wools. South Africa alone shows any promise of maintaining or increasing her output of fine wools. Equatorial Africa and South America may perhaps produce fine wools at the outset of the development of the sheep industry, but if they do they will be the first of equatorial regions to do so. Asiatic Turkey and Russia now yield 150,000,000 pounds of wool annually, mainly carpet wools, and seem unlikely to seriously change the character or volume of their output.

In view of these facts and tendencies a marked shortage and consequent high price for merino wools seems inevitable. In the early part of 1914 merino wools were much more eagerly sought than cross-breds, but the war commerce has given an active outlet for the stronger and more generally serviceable cross-bred wools. What the situation will be later can not be foretold. No doubt the ingenuity of manufacturers can devise methods and machinery to permit substitution for finer wools in some classes of fabrics. Possibly the science of psychology may direct tastes and fashions toward what is more readily obtainable. If not, the ladies will be first in experiencing the effects of the change, as it is for their use that most of the merino-wool fabrics are manufactured.

We should not ignore the fact that the types of the animals which produce so much of the materials of commerce are plastic things and have always been molded and remade in response to economic conditions. True, recent scientific discoveries give strength to the idea of constancy and the integral nature of some inherent factors. But these factors which refuse to change, even in the crossing of breeds, seem too numerous and minute to insure anything but the appearance of a blended form in such characters as length and fineness of wool fibers. We are not, therefore, unscientific or benighted in considering the probability of a reflection of economic conditions in the characters of our domestic animals.

It is practical to consider how far and in what way the probable values of finer wools will counterbalance the movement to produce the new type, which recent and present conditions of the meat supply have really required. The inferiority of the merino as a meat producer is too marked to be offset by even special value of wool except upon very limited areas which can support the growth of a fleece but can not support or market meat animals. We are not likely, therefore, to experience any general return to breeding for wool alone as a result of shortage of merino wools.

The disappearance of the merino in this hemisphere now seems to be imminent. If it does disappear it will be the first instance of the passing of any class of improved animals that had once gained wide distribution. All others of our European breeds of domestic animals have been practically remade to meet changing economic demands and material for newer types has usually been supplied from within the breeds themselves. Why, then, this marked exception to the usual course of affairs in the case of the merino? Strange as it may seem, the answer lies in its extreme speciali-



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zation for wool production to the exclusion of other important features. High degrees of specialization in domestic animals seem to have been generally attained in the interests of economy during the past four or five decades. However, there are some instances, and the fine-wooled sheep is one of them, in which true economy does not result from perfection in one function and the neglect of others. So assiduously and exclusively have the improvers of the fine-wooled sheep sought and bred for fineness and character of fiber with weight of wool that the muscular development in many cases is below what is requisite to that high constitutional vigor needed to enable the animals to hold a place as producers of meat in competition with breeds developed with greater consideration for flesh development.

The danger of the passing of this sheep of antiquity that has been the support of the pioneers of our western agriculture and civilizations is not alone due to the fact that the flesh development was ignored by nearly all those who contributed to the improvement of the merino as a producer of wool. Their animals are also nowadays decried because they exhibit the effects of breeding with too little regard for constitution, prolificacy, and rate of maturity. The corrugated skin, which is still quite generally but perhaps not correctly regarded as essentially associated with abundance and fineness of wool, is also in itself a detriment.

It would be beside the mark to recount the deficiencies of the merino if it were entirely too late to remedy them. It might be too late if we had earlier begun the perfection of a true breeding type with the characters of the cross-breds so largely produced. As it is, we may look for a twofold answer to the needs of the continuing sheep industry of arid lands. The Corriedale or its American analogue will have a wide distribution but can not replace that part of its ancestry which is merino in furnishing the finest wools. The merino improved in respect to its present weaknesses can continue to yield the choicest wools and also meet the needs of the special areas in which fine wool can safely be held as primary to other considerations.

In suggesting an improvement of the present defects of this sheep we confront the question, "Are not these defects a result of the perfection of the wool, and will the wool not be deteriorated by selections required to produce a plump-bodied animal of strong constitution and high or moderate fecundity?" Those who answer in the affirmative of course concede the early oblivion of the merino. But there are ample grounds in the history of breeding domestic animals for the belief that we can conserve the wool qualities of the merino disassociated from its present hindering defects. The history of breeding of stock and the light of experience with merino crosses suggest the need of effecting the change from within the breed itself without recourse to nonrelated stock, which, though it might quickly improve the weaknesses, would hopelessly dissipate the peculiar features of the merino fleece.

The sparsely fleshed body and low fecundity of the merino are not a result of the heavy growth of fine wool. Possibly ultra fineness of fiber may result from impaired vitality; but if so, equally necessary strength of fiber is lost, and there is no net gain. The limiting weaknesses of the merino are the result, in the United States at least, of a century of selection and breeding for fleece alone, and this with stock that came from Spain with a reputation for slowness of growth and low fecundity. It does not seem unreasonable to argue the possibility of developing a well-fleshed body beneath a fleece of fine fiber. The coarse-wooled Lincoln yields a greater actual weight of wool than does the merino, and at the same time furnishes maximum nutrition to a large frame and muscular development. The essential difference is in the diameter of the

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fiber. We still know too little of the nutrition of the body covering, but examples are not lacking to demonstrate the possibility of combining fineness of wool and heavy fleshing. At various times individuals who subscribe to this line of reasoning have made sufficient progress in their flocks to prove the correctness of their ideas. They seem to have lived too soon, however, as commercial demands, upon which they were dependent for support, did not then appreciate their animals as they would be appreciated to-day and will be in the near future.

The use of national funds for furnishing needed types of plants and animals is necessary. Government support for such work has been clearly justified in plant industry. With animals the task is slow of accomplishment, and heretofore needs have been less pressing. Government animal-breeding projects place a great responsibility upon those who select the lines to be followed. There may be errors in anticipating needs, but no workers can do more than proceed in the light of the best judging of existing conditions and tendencies.

## GOVERNMENT CONTROL OF GRAZING ON THE PUBLIC LANDS.

By ALBERT F. POTTER,

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The public grazing lands of the United States, or what is commonly known as the "free range," originally included practically the entire western half of the country. This was the Great Plains region, occupied by the Indians, and over which roamed innumerable herds of buffalo. Gradually the pioneer settlers moved the frontier westward until now it has almost entirely disappeared. The fertile lands which could be tilled were occupied by farmers, and the grazing lands used by the buffalo were taken possession of by the stockmen for their sheep, cattle, and horses. It has been the land of opportunity, open to all who were willing to bear the hardships of frontier life.

Legislation affecting these lands has been almost entirely in reference to the terms under which it might be located, settled upon, or purchased, or to the conditions under which it might be set aside for public purposes, such as military and Indian reservations or national forests. There have been no laws, however, which provided for any system of control in the use of the public lands for grazing purposes, and therefore they have been open to unrestricted use by whoever chose to graze his stock upon them. Naturally the more desirable areas, where feed was abundant and water plentiful, were chosen first, and as these became crowded the stockmen pushed on to the more distant localities, until finally the entire range was occupied by the owners of either cattle, horses, or sheep.

During this entire period competition for the use of the more desirable areas has been keen between the owners of the different kinds of live stock and between the owners of large and small herds. The only legal way in which a stockman could control the use of any portion of the public range was through acquiring ownership of the watering places upon it, and in this way preventing stock other than his own from using it. This led to location and entry under the public-land laws—first of the lands along the running streams or upon which there were living springs, and next of the lands upon which water could be developed by digging wells or building storage reservoirs. Thus a large proportion of the permanent watering places have passed into private owner-

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ship. Complete control of a range could not be secured in this way, however, because during the rainy season there was often an abundance of water in temporary lakes, tanks, or ponds, and during the winter time a sufficient supply furnished by the melting snow. Also there was no limit to the number of stock any owner of a watering place might turn loose upon the adjoining range, nor any restriction upon the kind of stock he might graze.

This system, or rather lack of system, inevitably led to controversy over the use of the range and to the grazing of a number of stock largely in excess of its normal capacity. In some localities it resulted in actual warfare between the different factions, with serious loss of both life and property, and in practically all localities it resulted in an economic loss through wasteful use of the range.

Probably the greatest handicap in raising cattle and horses on the public range is the prohibition against the erection of fences upon these lands. It is impracticable to handle cattle and horses in the same manner as sheep and goats—by keeping them constantly under herd. This means that in the absence of natural barriers, such as wide, deep rivers, canyons, cliffs, or high rough mountains, the losses from cattle and horses straying away are often sufficiently great to make unprofitable the raising of these kinds of stock. In some localities the fencing of private lands, rights of way of railroads, and wagon roads or large land grants has furnished the necessary barrier to keep stock within reasonable bounds. The need for fences in other localities has often been so great that stockmen have been tempted to construct such improvements in violation of the law, only to be required later to remove them and often to suffer the penalty imposed by the courts. Under these conditions much of the public range was best adapted to sheep raising, and the number of this kind of stock using it increased rapidly; in fact, some large sections of the range have been devoted almost entirely to the production of wool and mutton. The lack of any control, however, has been just as detrimental in sheep raising as in cattle raising, because there has been the same overcrowding of the range and the inevitable decrease in its carrying capacity and in the weight of the stock produced upon it.

A departure from the free-range system was made by the State of Texas in 1883 through legislation which provided for leasing its grazing lands. Texas is the only Western State which owns the public lands within its boundaries. Improvement was made by additional legislation from 1887 to 1897, and a system developed under which the welfare of the stockmen as well as the general prosperity of the State has been advanced. The general provisions of the Texas lease law are that outside of certain counties, 35 in number, which are known as the absolute-lease district, all lands not in immediate demand for settlement are subject to lease. The lands are leased in such quantities and under such conditions as may be considered best by the commissioner of public lands and for terms not exceeding five years, at a rental of not less than 4 cents per acre per annum, except that the lands deeded to the State University may be leased at 3 cents per acre.

The lands are subject to purchase by settlers at all times in lots of not more than four sections of 640 acres each, provided that not more than two sections are agricultural land. It is provided also that a settler purchasing one section may lease three additional sections located anywhere within a radius of 5 miles from the land occupied by him, provided the amount of land remaining under the original lease is not reduced below 10 sections. It is further provided that a settler must not turn loose more than 1 cow or 4 sheep for each 10 acres of unfenced land held by him either by purchase or under lease.

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Within the absolute-lease district the terms of the lease are extended to 10 years at the same minimum rentals charged for lands in the other district, but no land which has been classified as grazing land is subject to sale or lease to settlers and other persons during the tenure of the lease. At the expiration of a lease a period of 60 days is allowed within which the lands are subject to sale, and the lessee has a preference right to purchase. After the expiration of a lease the lessee has a preference right to a new lease.

The adoption of this system of handling its grazing lands by the State of Texas has brought about a great improvement in the range conditions within its borders. Each stockman knows just what amount of range he will be able to use and how many stock it should maintain. The areas leased are usually fenced by the stockmen, and this insures against straying of stock, which was one of the main sources of loss under the old free-range system. It also insures that the range will not be overstocked by the intrusion of stock owned by others. Under the pasture system each owner can carry out his own plan regarding the breeding of his animals and build up a herd of the kind and grade he desires to raise. The cost of handling the stock is reduced and the profits of the business increased accordingly. Encouraged by the reward of progressive effort, the lessee soon becomes interested in what can be done to improve the forage crop within his pastures and to increase their carrying capacity.

One of the first improvements has usually been the development of additional watering places through digging wells and erecting windmills. On some of the larger leaseholds windmills and reservoirs have been constructed at such intervals that the animals need not go more than 2 or 3 miles to water. The stock thrive much better under these conditions and the damage to the range from concentration of large numbers of stock at one watering place is avoided.

Next of importance has been the production of winter feed. The stockmen have found it possible to raise cultivated forage crops on portions of the leased land, and by this means have provided for wintering an increased number of stock. Such demonstrations of the agricultural value of the lands have led to increased effort by settlers and the transformation of some sections of the State from grazing to farming communities.

On the whole, the abandonment of the free-range system and adoption of the leasing system in Texas has resulted not only in the production of a largely increased number of live stock, but in the production of a much better grade of stock and in placing the live-stock industry on a sound business basis. It has also resulted in a more rapid development of agricultural lands and a marked increase in homestead settlement, all of which has added greatly to the development and general prosperity of the State.

Elsewhere in the West it has been customary for the States to lease the lands granted to them for school and other purposes preceding the sale of such lands under the provisions of their respective constitutions. These leases usually have been confined to sections which were particularly desirable, either by reason of their grazing value or strategic location. It sometimes happens that the only available water supply for a certain range or the key to desirable lambing grounds is located upon a school section. As a rule, the rentals by the State are graduated in accordance with the grazing value of the land and higher rates charged for watered sections than for those without water. The customary rates are from 4 to 12 cents per acre, although in exceptional cases rentals higher or lower than this are sometimes agreed upon.

Most of the grazing lands which have been selected by the States in satisfaction of grants, other than those for schools, have not been leased but have been sold to the stockmen. Oftentimes lands secured in this way have formed the

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nucleus for extensive operations on the adjoining public lands. Under this condition of affairs it is probably true that the States have received larger rentals and higher prices in the leasing or sale of their lands than would have been the case if these lands did not in a degree control the use of adjoining public areas which were open to free grazing. But that it is questionable whether in the long run this will yield the highest return is very clearly shown by the experience of the State of Arizona in connection with that portion of its lands which has been included in the national forests. The act of Congress admitting Arizona to the Union contained a provision that all of the school lands located within the national forests should be administered as part of the forests and such amount paid to the State each year from the gross proceeds of the forests as would be proportionate with the area of the school lands.

Under this plan the State received $28,966.46 as its share of the proceeds for the fiscal year ending June 30, 1915. During the year previous to the enactment of this law the returns from rentals for such portion of these lands as had been leased to stockmen was only $2,703.35. About one-half the national-forest receipts are for timber sales, so the revenue to the State from grazing is increased about five times.

This indicates that while higher rentals are secured for selected areas on account of their relation to grazing on the public lands, a much larger sum in the aggregate would be secured by the States for the use of their lands if these were used for grazing under some system of control similar to that in force upon the national forests.

The regulation of grazing upon the public lands of the United States is practically restricted to those lands which have been included within the national forests. The only exceptions are such portions of the remaining Indian reservations as ultimately may be restored to the public domain and a very limited amount of grazing on some of the military reservations and national parks. The net area of the national forests, excepting those in Alaska, is now about 137,000,000 acres, and the area of public land in the United States, excepting Alaska, remaining unappropriated and unreserved is about 280,000,000 acres. Therefore the use for grazing of about one-third of the public lands of the United States, excepting Alaska, is regulated, and the use of the other two-thirds unregulated.

The management of grazing upon public lands is as yet a comparatively new problem in this country, the legislation which authorized the use of the timber and other resources upon the national forests not having been enacted until June 4, 1897, less than 20 years ago. In the beginning the attitude of the Government tended to favor the exclusion of live stock, particularly of sheep and goats, from these ranges and to consider grazing as something which must ultimately be done away with on the national forest lands. For this reason there was very close restriction of grazing during the first few years and a material reduction in the number of stock occupying the ranges. A realization of the great importance of the live-stock industry and the necessity of using all the resources of the national forests, however, soon changed this attitude, and an era of progressive development began.

At the time of the transfer of the national forests to the Department of Agriculture by the act of Congress of February 1, 1905, there were 692,000 head of cattle and horses and 1,514,000 head of sheep and goats being grazed upon the 85,627,472 acres of national-forest land. At the end of 10 years, or for the fiscal year ending June 30, 1915, the number of stock has increased to 1,724,000 head of cattle and horses and 7,283,000 head of sheep and goats, and the area of the forests to 163,000,000 acres. This means that there has been an increase in the

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number of animals grazed 50 per cent greater than the increase in the area of the forests, or, in other words, that there are now 150 animals grazing on the same number of acres which supported only 100 animals 10 years ago. Not only that, but there has been a decided gain in the average weight of the animals and a marked improvement in the grade of stock produced. This great and beneficial change has been brought about through the policy of allowing the fullest use of the forests consistent with their permanent maintenance and by the adoption of a constructive and progressive plan in the management of grazing.

The principles which have governed the development of grazing lands within the national forests are:

1. The use of each range by the kind of stock for which it is best adapted.
2. The use of each range during the portion of the year when it can be grazed to best advantage.
3. Prevention of overgrazing by limiting the number of stock grazed to the normal capacity of the range.
4. Development of watering places and construction of bridges and trails to bring new range into use.
5. Even distribution of stock upon the ranges and improved methods of herding.
6. Reseeding the ranges by natural and artificial means.

The national forest ranges contain a great variety of shrubs, plants, and grasses. Fully 3,000 different species have been collected and identified. A very large proportion of these have at least some forage value. Some are relished particularly by cattle and others are sought by sheep. Likewise some are particularly valuable as forage for one kind of stock or the other. As a rule sheep require and eat a much wider variety of plants and grasses than cattle. What are known as weed ranges are especially well adapted to sheep grazing, and this kind of stock thrive on plants which would not be touched by cattle and horses. Sheep are well adapted to grazing in the rougher portions of the range and at the higher altitudes, while cattle prefer the smoother open country and the lower valleys.

It is the universal custom on the public range to herd sheep and to turn cattle and horses loose. This means that sheep may be kept within the limits of a designated range without additional expense, while to do this with cattle and horses it is necessary either to employ additional riders or to fence the range. To meet this need in grazing cattle and horses the Government has allowed the construction upon the national forests of such drift or division fences as were necessary properly to control the stock and keep it within designated bounds. In fact, in many instances the Government has cooperated with the stockmen in the construction of such fences and has borne part of the cost.

There is a much wider distribution in the ownership of cattle than of sheep, the average cattle permit on the national forests being for only 57 head, while the average sheep permit is for 1,465 head. This means that the cattle are run largely in connection with local farms, and of necessity the range allotted to these small owners must be near by. By the establishment of general grazing districts for the different kinds of stock a more economic use of the forage is secured, the needs of the different owners are better met, and more and better stock is produced.

The use of the different ranges during the portion of the year for which they are best suited is of the greatest importance. It is impossible for stock to remain on the higher mountain ranges within the national forests during the winter; after the summer season is over the animals must be removed to

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ranges at lower altitudes or wintered upon the farms. There are immense areas of winter range outside the national forests which produce forage crops that can be harvested only by grazing live stock. Through lack of a permanent water supply or because the feed dries up, much of this range can not be used during the summer, and the stock must return to the higher ranges, largely within the national forests, for summer grazing.

The farmer who raises hay and grain depends largely upon live stock to furnish a market for at least a portion of the product of his lands by converting it into beef, mutton or dairy products, and near-by range must be had for this stock while the farm crops are being grown. This is often found upon the national forests. Many of the most desirable lambing grounds are located within the national forests, and their use during the spring season is of vital importance to sheep owners. In moving stock to these summer ranges care must be taken not to put the stock on them before the feed has made a good start and the ground has hardened sufficiently to bear the weight of the animals. To do so would cause an economic waste and soon reduce the carrying capacity of the lands. To secure the best use of the ranges grazing periods are established for the national forests in accordance with local conditions and needs, and stock are allowed to use them only during the periods for which they are suited. The usual summer grazing period is from May 1 to November 30, and on the higher ranges from June 15 to October 15. A variation from the fixed dates is allowed whenever the seasonal conditions warrant it.

Many of the national forests in the Southwest include winter ranges, and there grazing is allowed during the entire year, the stockmen being required to remove a number of stock each year equal to the natural increase. Summer and winter grazing districts are established and the stock is moved from one to the other in accordance with the requirements of the season. Only by a systematic division of the ranges to meet the needs of the different seasons can a proper balance be maintained.

It is equally if not more important that the number of animals using the ranges during the different periods be limited to their normal grazing capacity, and that overstocking be avoided. Nothing else has been so destructive as overcrowding the ranges, and all other means for improvement will fail if overgrazing is persisted in. After a careful study of each range an allowance is fixed upon the basis of the number of each kind of stock it will support under normal conditions during the period it is to be used, and permits are issued only for that number of stock.

These estimates must necessarily be made in advance, and if it turns out to be an unusually favorable season there will be a surplus of forage. Increased allowances are not made on this account, however, because if the range is fully stocked in the abnormally good years it is sure to be overgrazed in bad years. By restricting the number of animals to the capacity of the range in normal years, an exceptionally good natural reseeding is secured in good years, which helps to carry them over in bad years. Not only that, but in the end the normal carrying capacity of the range is gradually increased by this method and more stock can be cared for upon it.

When the ranges included in the national forests have been found to be overstocked, the number of animals has been reduced gradually from year to year until a proper limit was reached. By this method the stockmen have been given ample opportunity to dispose of the surplus stock without serious loss. Oftentimes the removal of this surplus stock from the forest has been avoided by opening up new range which before had been unused. This usually requires the construction of trails or driveways, bridges to cross streams, or the development

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of water. Through improvements of this kind the use of the national forests for grazing has been largely extended and a more complete utilization of its forage resources secured.

Much progress has been made in improvement of the range by better methods of herding and handling the stock. By the construction of drift fences, by the development of additional watering places, and by care in the selection of salting grounds, a much better distribution of cattle has been secured and the condition of the range greatly improved.

The first change made in handling sheep was to require that they should not be bedded more than six nights in the same place, except when this was clearly impracticable. There are few portions of the range so rough that a sufficient number of bed grounds can not be found to provide for a change at least every six nights, and the adoption of this plan very quickly eliminated the damage which was being done by continuous bedding in the same place. It practically did away with the old system of corralling the sheep at night, except during the lambing season. The next change was the adoption of what is generally called the "loose herding" or "bedding out" system, under which the sheep are bedded where night overtakes them, often in a different place each night. This was the outgrowth of pasture experiments conducted by the Forest Service during a period of years in which it was found that sheep turned loose in pasture required only two-thirds as much range as sheep herded under the prevailing system, and also that lambs from the herds grazed loose in pasture weighed 10 per cent more than lambs from those herded outside. Owing to the topographic features of the country, the prevalence of predatory wild animals, and the necessity of moving stock long distances between summer and winter ranges, the general adoption of the pasture system in ranging sheep is impracticable on the greater part of our range country. Therefore an effort has been made to approach as near as possible the pasture conditions while still keeping the sheep under herd. This has been accomplished by giving the sheep the greatest possible freedom in their movements during the day and bedding them where night overtakes them. By the adoption of this system the stockmen in many cases have been able to increase the weight of the lambs raised upon the same range fully 5 pounds, and at the same time the number of animals grazed has been increased from 10 to 25 per cent. There has been some difficulty in getting the herders to adopt the new system, for the reason that it means harder work, but experience has shown that after the sheep get used to the open system of herding and being bedded out at night they are no harder to handle than under the old close herding system.

Reseeding the ranges by the introduction of cultivated forage plants has been confined almost entirely to the mountain meadows and alluvial bottoms along the creeks. It has been found that timothy ordinarily is the best species and that one year's protection from grazing is necessary after seeding. It is possible in many localities at a very small cost to divert the water at the heads of meadows and by scattering it out over the area and seeding with timothy to increase the forage crop from 100 to 400 per cent. This method of procedure, however, is both slow and expensive, and the greater part of our range lands, at least until we know more about artificial reseeding, must be improved by protection and natural reseeding. Investigations have established beyond doubt that natural reseeding can be accomplished best by a rotation system of grazing, based upon the simple principle that after the vegetation has matured its seed, approximately from August 15 to September 15, grazing aids in scattering and planting the seed. Experiments have shown that the vegetation upon tracts grazed each fall after the seed had matured is 50 per

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cent better than upon areas from which the stock had been totally excluded, and probably 200 per cent better than upon range without protection. This system offers great encouragement in range management, since there is almost no waste of forage and consequently the stockmen suffer no loss in adopting it. It gives better results than total exclusion of the stock and prevents the accumulation of coarse, unusuable forage and other inflammable material which is a menace to the forest. This means that the ranges can be improved faster in use than in idleness.

The allotment of grazing privileges on the national forests is based upon prior use of the range, ownership of improved ranch property, dependence upon the range for a livelihood, and utilization of the forage resources. Upon the inclusion of lands within a national forest the stockmen who have regularly occupied them during previous years are allowed to continue grazing their stock, subject to such readjustments as may be necessary to prevent damage to the forest and to secure an equitable distribution of the grazing privileges.

In the renewal of permits the small owners who are dependent upon the range for a livelihood, or for the successful operation of their farms, are given the preference, and any necessary reductions are made on the permits of the larger owners and transient users. Preference is also given to resident ranch owners, and no new owner is allowed a permit unless he is also the owner of ranch property commensurate with his stock and which will be used in connection with his grazing operations. Protective limits are established in accordance with local conditions to meet the needs of small owners and to fix the number of stock for which permits are renewed without reduction. Maximum limits that fix the total number of stock for which permit may be held by any one individual, firm, or corporation are also established to prevent monopoly.

When the range within a national forest is fully occupied by regular users, the approval of applications for grazing permits other than for renewals is restricted to resident ranch owners whose ownership of stock does not exceed the protective limits; but when there is surplus or unused range, temporary permits are allowed for numbers of stock not in excess of the maximum limits, which become renewable after three years' use of the range, provided it is not applied for in the meantime by smaller owners.

Reductions upon the permits of the larger owners are restricted to not more than 10 per cent in any one year on the permits of those who own ranch property commensurate with their stock, and not more than 20 per cent in any one year on the permits of regular users who do not own ranch property. Renewal of permits is allowed to purchasers of stock grazed upon the national forests, subject to 20 per cent reduction when only the stock is purchased and 10 per cent reduction when both the stock and ranches used in connection with it are purchased, if such reduction is necessary to provide range for small owners or new settlers within or near the forests.

Under this plan it will be seen that the permits of the larger owners are being constantly reduced to provide range for new settlers and the smaller owners, thereby securing a wider distribution of the grazing privileges. At the same time, this is being done in a way which protects the larger owners from serious financial loss and gives them an opportunity to gradually readjust their affairs to meet the new conditions. This is accepted by the stockmen as fair to both the small and large owners, as it gives the former an opportunity to gradually build up to a point where he can operate profitably without reducing the latter at a rate which would cause him undue hardship. Stability

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has been given to the live-stock industry under the permit system for the reason that each stockman knows in advance not only just how many stock he may expect to secure a permit to graze, but also that when the stock enter upon the range there will be ample feed to support it.

The grazing fees upon the national forests, which average about 13½ cents per head per annum on sheep and 54 cents per head per annum on cattle, are very moderate as compared with the actual commercial value of the forage based upon the charges made for the use of privately owned lands. The rates for horses are usually 25 per cent more than the rates for cattle and the rates for swine 40 per cent less. No charge is made for animals under six months of age, which are the natural increase of stock grazed under permit. The charge for short seasons is proportionately lower than the charge for the full year.

In the beginning no charge was made for grazing on the national forests because the stockmen had always enjoyed the use of this range free of charge while it was part of the unreserved public domain. But because stockmen using the protected and regulated range within the forests have many advantages not enjoyed by those who are occupying the unregulated range outside, it was deemed fair and just that they should pay a moderate fee which would go toward reimbursing the Government for the cost of protecting and administering the forests. The charge, therefore, is not the full value of the forage, but an amount fixed by the Secretary of Agriculture which is deemed fair and reasonable for the privileges enjoyed by the stockmen on the national forest ranges. The permits are on a per capita rather than on an acreage basis, for the reason that proper care of the forests demands that there shall be flexibility in the range allotments and opportunity to move stock from one portion of the range to another when the needs of the forest demand it, and also because it is necessary to use many portions of the national forests as community ranges.

Certain kinds of stock are exempt from permit and allowed to graze free of charge. These are the milch and work animals of settlers, to the number of 10 head each, and animals which are used in carrying on the different operations on the national forests, such as teams used in construction work, teams used in logging, saddle horses used in caring for stock grazed under permit, etc. The amount of range required for this kind of stock is estimated each year and allowance made for it in fixing the number of stock to be grazed under permit.

When the regular public highways are inadequate to meet the needs, free movement of stock across the national forests from one point to another is provided for by the establishment of driveways, and crossing permits are issued free of charge for stock to be driven to and from shipping points, between summer and winter ranges, to shearing or dipping pens, or from the outside range to private lands within the forests. Under this system the use of the outside public lands or the privately owned lands is not interfered with, except by such regulation as may be necessary to protect the forests.

When natural range units are only partially included within the national forests, and it seems inadvisable to fence the forest boundaries, grazing is provided for under what are known as "on and off" permits, which require payment of fees upon the proportionate number of stock which will be grazed upon the national forest lands, with the understanding that not more than an agreed number of stock will be grazed upon the entire range. This same plan is also adopted when as much as 50 per cent of the lands within any portion of a forest are in private ownership and unfenced. A different system, however, is usually applied in reference to unfenced private lands within the forests. It is to allow free grazing of the number of animals the private lands

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will support in exchange for the use of the private lands by other permittees on that portion of the forest. This is fair to both the Government and the private land owners, and not only obviates the necessity of fencing, but allows a more even and better use of the range.

The direct interest of the stockmen in the management of the national forest ranges and the advantage to the Government in having their cooperation and assistance led to the early adoption of the plan recognizing advisory boards which represent the users of the range, and consulting with them regarding matters which affected the general welfare of the live-stock industry. The organization of live-stock associations was encouraged wherever such associations did not already exist, and the cooperation of the stockmen was invited in all matters concerning the better use of the range. The only requirements for recognition are that the association shall represent a majority of the users of the range, that all permittees shall be eligible to membership, and that its constitution and by-laws shall not be in conflict with the regulations governing the national forests. Under this plan over 225 associations have been recognized and are working in cooperation with the Forest Service for the protection and improvement of the national forest ranges and the advancement of the live-stock industry.

In protecting the stock using the national forest ranges from infectious and contagious diseases, the Forest Service has worked in cooperation with the Bureau of Animal Industry and the State live stock sanitary boards by requiring that all quarantine and sanitary regulations be complied with before stock are allowed to enter the forests.

In the extermination of predatory wild animals, the Service has worked in cooperation with the Biological Survey and, through the employment of expert hunters and furnishing ammunition and traps to the regular forest officers has done much to rid the ranges of this great menace to the live-stock industry. This work, however, is only just well begun, and much remains to be done in reducing this most threatening cause of loss to the stockmen.

Investigations of poisonous plants have been carried on in cooperation with the Bureau of Plant Industry, with a view to the discovery of antidotes and remedies for the poison and means of eradicating such plants from the range. In many instances the losses from this cause have been overcome by learning the time of year when certain plants were in the poisonous stage and keeping stock off the range during that period. In other instances certain portions of the range containing poisonous plants have been fenced to keep the stock off. Experiments have been made in grubbing out the poisonous plants and other means of eradicating them and much progress made along this line. This work will be continued in cooperation with the Bureau of Animal Industry, to which it has recently been transferred, and the experiments and investigations extended to all methods which offer any possibility of decreasing the losses of live stock from this cause.

The system under which the national forest ranges are being used can well be summed up by the following statement of the principles which govern it:

1. Limitation in the number of stock grazed and the portion of the year during which the range may be used.
2. Division of the range between the different kinds of stock and its owners.
3. Permits on a per capita basis instead of leases on an acreage basis.
4. Free grazing for milch and work animals of settlers and all animals used in operations upon the forests.
5. Charges for ranging stock at moderate rates fixed by the Government instead of at market values fixed by competitive bid.

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6. Preference to small owners and prior users.
7. Renewal of permits to purchasers.
8. Maximum limits to prevent monopoly.
9. Exchange in the use of private lands.
10. On-and-off permits for ranges only partly within the forests.
11. Cooperative construction of range improvements.
12. Recognition of advisory boards to represent users of the range in the adjustment of range matters.

In working out this system much has been gained by reference to such information as was available regarding the methods which have been adopted in other countries. Whenever these have been applicable to the conditions in this country, advantage has been taken of the experience of our neighbors. There are many problems, however, which seem to grow out of our public-land policy or to be presented by local conditions upon our ranges, which must be solved in the way that is most practicable under the existing laws and conditions and which will be best for the public welfare.

If any of the methods which we have adopted for improvement of the public grazing lands or advancement of the live-stock industry offer suggestions which may be adopted with advantage by our neighbors in the Pan American countries, we shall feel that we have been doubly repaid for our efforts.

## GREAT CENTRAL MARKETS FOR LIVE STOCK AND MEATS.

By LOUIS D. HALL,

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The term "great central markets," as used in this paper, refers to those markets to which shipments of meat animals are brought from comparatively long distances over various railroad lines converging at the market points, and from which meat products and animal by-products are distributed through interstate or international channels of trade. Three fundamental factors or functions form the framework of such a market, namely, a stockyards company, live-stock commission firms, and meat-packing companies.

The stockyards company unloads the animals from the cars, delivers them to the commission companies to whom they are consigned, loads stock for reshipment, furnishes pens, sheds, sorting alleys, viaducts, feed, water, scales, dipping and branding facilities, and office buildings for the use of commission firms, railroad officials, banks, and others. In many instances the stockyards company also owns the terminal railroad tracks leading from the main lines to the unloading docks at the stockyards; also stockmen's hotels, live-stock exposition and auction buildings, and sites upon which packing houses and related manufacturing industries are located.

Commission firms receive consignments of stock in carload or train lots from their clients in the country; attend to the yarding, ordering of feed, and watering the animals; sort or classify the stock, if necessary, into salable lots; sell and deliver them to the scales, collect the proceeds from purchasers, pay freight, yardage, feed, insurance, terminal switching or other charges incurred; and remit the balance due or deposit the amount as directed by the consignor. They purchase stock, upon orders, for grazing, feeding, and in some cases for

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slaughter, and are extensively engaged in loaning money to growers and feeders of stock for whom they buy and sell.

Meat-packing companies buy such of the offerings of stock on the market as are suitable for dressed meat or meat products, and either slaughter them locally or ship to their plants at other points. About 98 per cent of the cattle sold for slaughter at the largest stockyards in the United States are bought by five of the leading packing concerns. Besides the packing business proper, these firms are engaged in numerous related industries and interests, including extensive stock growing and feeding operations, stockyards banks, live-stock loan companies, terminal railways, stockyards, market papers, refrigerator-car lines, branch wholesale houses, cold-storage warehouses, poultry, butter, egg and fruit packing and distribution; and large numbers of retail meat markets are said to be directly or indirectly controlled by them.

At most of the central stockyards the various commission men, buyers, and others who operate on the market are associated in a "live-stock exchange," the purposes of which are to regulate market practices, such as charges, dockages, terms of sale, market hours, the general protection of members, and promotion of mutual interests. Speculators and traders or "scalpers" who operate on other than a commission basis are organized at several of the markets as "traders' live-stock exchanges." Daily market papers are published at all the larger stockyards for the reporting of receipts and shipments, quotation of prices, and dissemination of general market information.

Contrasted with the live-stock markets and meat-packing centers of the United States, and of Argentina, which typify a highly developed centralization of live-stock marketing and meat packing, are the small local markets of European and Asiatic countries, in which meat animals generally are purchased and slaughtered in small numbers at the cities and villages where the meat is consumed; the marketing methods remaining essentially the same as the simple practices that have prevailed since ancient times. Each of the two systems is a logical result of different economic conditions. Local marketing and utilization of meat animals naturally prevails where no surplus of meat animals is produced; where facilities for the transportation of live stock to distant points are inadequate; where cheap local labor enables small butchers to supply meats at moderate prices; where public demand favors the medium or lower grades of meat, and economy rather than quality or appearance is the important consideration; or where, as a matter of custom, farmers and tradespeople gather on regular market days for the sale of their products and purchase of necessities. These conditions in whole or in part explain the adherence of all Old-World countries to the local market day or fair as the principal outlet for farm live stock.

The factors that have contributed chiefly to the creation of great live-stock market centers in the newer countries of the Western Hemisphere are a great surplus of animals for export, resulting in a concentration of stock for shipment either alive or in the form of meat products; unequal geographic distribution of the live-stock supply in relation to population, causing a movement of marketable stock toward consuming districts, thus tending to centralize the sale and utilization of the animals and their products; rapid extension of railroads, facilitating the shipment of stock from grazing and feeding areas; the application of refrigeration to the shipment of fresh meats, cutting down the cost of distribution by the reduction of bulk and shrinkage, besides making it possible to deliver meats to more distant points and in better condition than when shipped on foot; the invention of the tin can and its adaptation to the preservation of meats and meat products in such form as to permit their con-

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venient carriage in perfect condition to the equator or the poles; scarcity of labor in live-stock producing sections and concentration of laboring classes at railroad centers, thus attracting slaughtering industries to the latter; and demand in consuming centers for high-grade meats attractively dressed and carefully prepared in sanitary plants under official inspection, with corresponding discrimination against meats dressed in amateur fashion and handled without due regard to refrigeration and sanitation, as too often is the case in small local markets.

Conditions which are essential to the development of an extensive live-stock and meat-market center, as indicated by the history of successful and unsuccessful enterprises of this kind, are an adequate and constant supply of live stock of the proper kinds to yield the classes and grades of meat in demand at accessible consuming points; transportation lines tapping live-stock producing territory and equipped with loading stations, rolling stock, and terminal facilities adapted to the rapid and safe delivery of live stock at reasonable rates; ample capital to provide stockyards equipment, including terminal trackage; well organized and adequately financed meat packing plants, including industries for the complete utilization of by-products and ample distributing facilities; sufficient laboring population to man the slaughtering and allied industries; and a large contiguous consuming population to provide a demand for certain meats and edible by-products that are best adapted to immediate use in fresh form. The indispensability of each of these conditions can not be emphasized too strongly. Communities which lack any one of them should not permit the promotion of pretentious stock-yards enterprises by private parties whose prime motive frequently proves to be the sale of shares to persons who are unacquainted with the elementary requirements of such a project.

A brief account of the growth of live-stock markets in the United States of America will serve to illustrate some of the foregoing fundamental economic factors and indicate, in some degree at least, the course of development to be anticipated under comparable conditions in other countries.[1] Until the middle of the last century the only considerable markets for fat cattle were east of the Allegheny Mountains, New York, Philadelphia, and Baltimore being the principal market centers. Until the early fifties it was customary to take cattle to market on foot. In many instances this involved a drive of a thousand miles, requiring 10 to 12 weeks. It was not uncommon for cattle to be driven to the large eastern cities from points as far west as Iowa and Texas. Pork packing, however, became an important industry in the Central States during this period—first at Cincinnati, later at Alton, Ill., and simultaneously at other points on the Ohio and Missouri Rivers.

One of the first shipments of cattle by rail was sent in 1852 from Kentucky to New York. About 1855 shipments by rail were made from Indiana to New York, and in the same year began the shipment of cattle east from Chicago.

In 1857 the Ohio and Mississippi Railroad was extended from Cincinnati to St. Louis. Here it connected with the Missouri Pacific, which was completed to Kansas City in 1865. At the same time rail service was established between Kansas City and Chicago. During the succeeding quinquennium, immediately after the Civil War, several significant factors combined to revolutionize the marketing of meat animals in the United States. Rapid increase in population

[1] The text and statistical matter here presented (pp. 337 to 340) are adapted in part from University of Illinois Agricultural Experiment Station Circular No. 169, pp. 3–16, and United States Department of Agriculture Yearbook, 1908, pp. 231–243.

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and the development of manufacturing industries in the East and North brought about a new demand and a larger outlet for meat products. Railroad extension throughout the Middle West made possible the establishment of central markets which became accessible to live-stock producers at long distances.

Along with better facilities for shipping live animals came improved methods for transporting fresh meats. The invention of the refrigerator car in 1868 made it possible to slaughter cattle in the West and ship the dressed beef to the large eastern cities and to Europe. This system became well developed by 1875. About the same time the use of the tin can was introduced into the meat-packing industry, and it contributed still further to the successful shipment of meat products to distant parts of the world. Thus the cost of transportation was greatly reduced by the concentration of bulk, and the packing business was extended throughout the year instead of the four winter months to which pre-

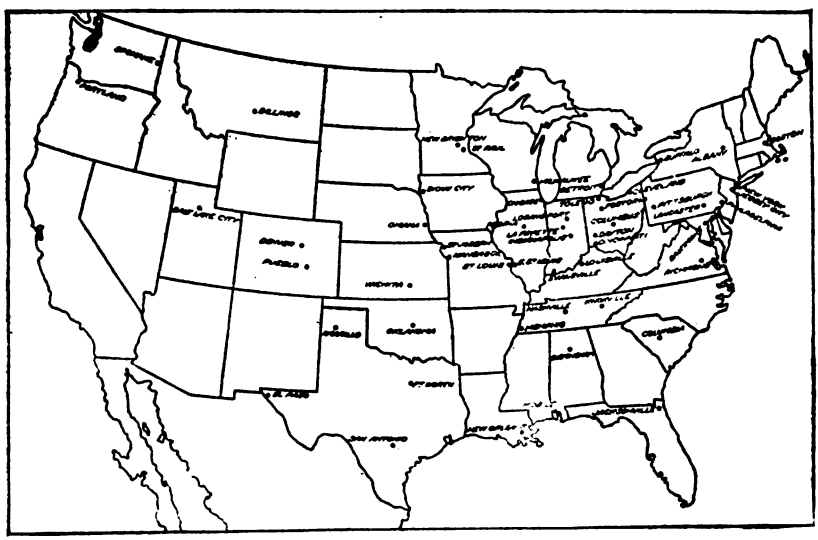

FIG. 1.—Centralized live-stock markets.

viously it chiefly had been confined. The utilization of by-products that formerly were wasted also began to receive attention. These factors, together with extended utilization of the grazing and feeding sections in western and central States, the building of railroads, and the development of agriculture and industry in general, combined to work the most important turning point in the annals of American meat production and the real beginning of great centralized live-stock markets.

A summary of the receipts and shipments of cattle recorded at the principal live-stock markets at decennial intervals from 1870 aptly indicates the rapid development of centralization and its gradual extension westward toward the sources of supply. Table 1 presents these data, the markets being arranged in the order of their gross receipts of cattle in 1910. The map (fig. 1) may be consulted in connection with the tables.

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TABLE 1.—*Numbers of cattle received annually at the larger markets of the United States at 10-year intervals, 1870 to 1910.*[1]

[Circ. 169, Ill. Agr. Exp. Sta.]

| Market. | 1870 [2] | 1880 [3] | 1890 [3] | 1900 [3] | 1910 [4] |
|---|---|---|---|---|---|
| Chicago | 533,000 | 1,382,000 | 3,484,000 | 2,729,000 | 3,053,000 |
| Kansas City | [5] 121,000 | 245,000 | 1,472,000 | 1,970,000 | 2,230,000 |
| Omaha | | [6 7] 87,000 | [7] 607,000 | 828,000 | [7] 1,223,000 |
| St. Louis | [7 8] 234,000 | [7] 346,000 | [7] 511,000 | [6] 698,000 | [7] 1,207,000 |
| Fort Worth | | | | 90,000 | 785,000 |
| New York | | [6] 683.000 | [6] 674,000 | [6] 630,000 | 615,000 |
| St. Joseph | | | [7 9] 28,000 | 380,000 | 510,000 |
| St. Paul | | [10] 32,000 | 93,000 | 176.000 | 482,000 |
| Sioux City | | [7 10] 55,000 | [7] 167,000 | 300.000 | 411,000 |
| Denver | | [7 11] 54,000 | [7] 114,000 | 240,000 | 383,000 |
| Indianapolis | [7 12] 119,000 | [7] 133,000 | [7] 120,000 | 140,000 | 309,000 |
| Cincinnati | [6 8] 128,000 | [6] 189,000 | [6] 172,000 | 177,000 | 257,000 |
| Buffalo | | | | 654,000 | 220,000 |
| Pittsburgh | | | | 251,000 | 150,000 |
| Baltimore | | | | 163,000 | 142,000 |
| Philadelphia | | | | 165,000 | |
| Jersey City | | | | 228,000 | |
| Boston | | [6] 227,000 | [6] 168,000 | [6] 178,000 | 128,000 |
| Louisville | | | | [6] 94,000 | 126,000 |
| Portland, Oreg | | | | | 90,000 |
| Seattle | | | [13] 10,000 | [13] 19,000 | [13] 55,000 |

[1] Calves not included.
[2] Bureau An. Indus. Rept., 1897, pp. 209–239.
[3] Bureau An. Indus. Rept., 1900, pp. 569–583.
[4] Chicago Drovers' Jour. Yearbook, 1911. Stock Yards Co. Repts.
[5] 1871.
[6] 1884.
[7] Includes calves.
[8] 1874.
[9] Statistical Abstract of United States, 1910, p. 495.
[10] 1888.
[11] 1886.
[12] 1878.
[13] Estimated.

NOTE.—Omissions in this table are due to the fact that statistics were not obtainable, either because a market had not been established or because no records were kept.

The relative importance of the various markets as cattle slaughtering centers may be determined approximately by deducting shipments from gross receipts, thus showing the net numbers of cattle actually utilized. On the basis of statistics for 1910, so far as obtainable, the leading markets ranked in the order indicated in Table 2.

TABLE 2.—*Net receipts and shipments of cattle at large markets, 1910.*

[Circ. 169, Ill. Agr. Exp. Sta.]

| Market. | Net receipts.[1] | Proportion of shipments to gross receipts (per cent). | Stockers and feeders shipped. | Proportion of stockers and feeders to shipments (per cent). |
|---|---|---|---|---|
| Chicago | 1,741,000 | 43 | 406,000 | 31 |
| Kansas City | 1,286,000 | 42 | 631,000 | 66 |
| St. Louis | 897,000 | 31 | 101,000 | 27 |
| Omaha | 799,000 | 35 | [2] 432,000 | 102 |
| Fort Worth | 529,000 | 33 | | |
| St. Joseph | 355,000 | 30 | 59,000 | 38 |
| Sioux City | 200,000 | 51 | 178,000 | 84 |
| Cincinnati | 188,000 | 27 | | |
| Indianapolis | 169,000 | 45 | | |
| St. Paul | 146,000 | 70 | 261,000 | 71 |
| Buffalo | 120,000 | | | |
| Louisville | 63,000 | 50 | [2] 42,000 | 66 |
| Baltimore | 63,000 | 55 | | |
| Boston | 61,000 | 52 | | |
| Portland, Oreg | 51,000 | 43 | | |

[1] Receipts minus shipments. [2] Includes feeders driven out. [3] Estimated.



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Chicago is seen to stand first in net as well as gross receipts, followed by the five "Missouri River points" and Fort Worth, Tex. At the principal packing centers approximately 60 to 70 per cent of the receipts of cattle are slaughtered. The extreme ratio of 70 per cent of shipments to gross receipts shown for St. Paul is explained by the large numbers of western cattle fed in transit at that point. Sioux City and Denver, likewise, are feeding stations for cattle en route to northern ranges and for range cattle in transit to other markets. Referring to the last two columns, it is observed that Kansas City outrivals all other centers as a feeder market, both as to the actual number shipped out and the proportion of feeders to total shipments. Omaha occupies second place and is regarded by corn-belt cattlemen as a rapidly growing feeder point. The excess of feeders over total shipments at Omaha is due to the large number of feeding cattle driven out of the yards and not counted in shipments. As to the actual number of feeders shipped, Chicago ranks close to Omaha, although less than one-third of the cattle shipped from Chicago are feeders. The high percentage of feeders in shipments from Sioux City, Denver, and St. Paul consists largely of cattle fed in transit, as explained above.

Swine and sheep, as well as cattle, figure largely in the receipts at the more important central markets mentioned in preceding paragraphs. Generally speaking, the various markets rank in about the same relation with reference to the numbers of those classes of animals handled as in the case of cattle, and, considering the limits of this paper, the statistics given will suffice to indicate the distribution and comparative magnitude of the various stock yards and packing centers.

Concerning the place of the central markets as a factor in the live-stock trade of the country, it is estimated from statistics compiled by the United States Bureau of Corporations that approximately 55 per cent of the total number of cattle sold for slaughter are marketed at the large stock-yards centers and packing points, about 35 per cent are slaughtered in other cities and villages, and the remainder, about 10 per cent, are slaughtered on farms and ranges. As a further indication of the degree of centralization that characterizes live-stock marketing in this country, it may be mentioned that five packing concerns have been found to slaughter about 98 per cent of the cattle handled at the eight leading western packing centers, and that among all the establishments in the United States at which animals are slaughtered under Government inspection (numbering nearly 1,000 establishments in about 250 cities) the same five concerns slaughter more than two-thirds of the cattle and sheep and more than half of the hogs and calves.

Numerous and far-reaching problems peculiar to this country have developed in connection with the unprecedented growth of our live-stock and meat-packing centers. Chief among these problems, perhaps, are the fluctuations in market prices and in supplies at the great markets, and the tendency to concentrate at these centers in the hands of market interests the capital required to finance the growing and feeding of live stock by grazers and farmers. It recently has been stated by the president of the American National Live Stock Association that these market fluctuations and difficulties in financing live-stock paper are among the most important influences toward discouraging the raising and maturing of more live stock, and that "it may be that so long as the present centralization of the meat-packing and other allied industries at large markets continues it will be difficult to correct the evils flowing from wide fluctuations in prices."

On the other hand, the average price of live stock on farms and ranges has risen rapidly during the past decade; and, although the cost of production is

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correspondingly higher, recent investigations indicate that the relative expense of marketing meat animals has not increased materially, if at all. It must be said, too, that the relative cost of selling live stock compares favorably with that incurred in the sale of any other farm product. Consequently, notwithstanding obvious and even serious imperfections in our great central live-stock markets, it is not too much to say that in their essential features they represent a natural adaptation to the conditions under which they have attained their present magnitude.

## TRUCK MARKETING ON A LARGE SCALE UNDER COOPERATIVE PRINCIPLES.

By N. P. WESCOTT,

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Of all those current developments and innovations which may be said to make up the general industrial drift of the present hour, there is perhaps none of more inviting promise or of a more disheartening array of recorded failures than the cooperative marketing of farm products. Yet a few conspicuous successes prove the applicability of the cooperative principle to this field and demonstrate its great fruitfulness when correctly applied. And in the critical study of these exceptional farmers' associations that have succeeded, the necessary conditions of success should become apparent and the dangers which chiefly threaten this form of enterprise should be revealed. It is the purpose of this paper to record briefly the salient features and conclusions of such a study of the Eastern Shore of Virginia Produce Exchange, a cooperative association which for the past 16 years has marketed a preponderance of the farm products of that section of Virginia lying east of Chesapeake Bay, and which, having achieved throughout that period an unbroken if varying success, and having withstood all attacks from without and violent dissensions within its ranks, seems now to have earned standing as a probably permanent institution.

The territory covered by this association is a compact, closely cultivated peninsula, long devoted to the production of truck crops. In May it harvests strawberries, in May and June cabbage, in June and July onions, from June to July Irish potatoes, and from August to November sweet potatoes—the two last, and especially summer Irish potatoes, far exceeding all the others in importance. None of these products can be successfully stored and all must find quick outlets. There are no local markets; and the present production many fold exceeds the consuming capacity of the big near-by eastern cities, which are apt always to be flooded with a myriad of small "consignments" of similar goods from the entire South Atlantic seaboard. In the 10 years preceding the establishment of cooperating marketing, the plan of selling by the individual farmer to speculative local buyers and to brokers of distant produce houses was thoroughly tried out and proved to be generally destructive of any chance of prosperity for the farmer. The farmers, unorganized, uninformed as to general market conditions, and with no chance of holding their perishable goods, were generally constrained to take whatever price the local buyers offered. The buyers, relatively few in number, scattered among the numerous shipping points of the peninsula, and having generally an ample supply

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of goods to draw from, found their competition mainly in the selling end of their business. Moreover, as they operated generally on a flat brokerage or per-package profit, they had a positive interest in hammering down prices to levels that would enable them to do an increased volume of business on their limited capital. Under these conditions, inevitably, all years were apt to be bad years, any expansion was discouraged, and chronic hard times prevailed.

To combat these conditions, to substitute unanimity of action for the ruinous if unconscious competition of a great number of small producers, to provide on behalf of the farmer a real voice in the bargain by which his goods are disposed of and to secure for him the benefits of constant, vigorous and intelligent cultivation and expansion of the available markets, the exchange was organized. Its undertaking broadly is to receive and load the products of its members, to maintain such standards of culling, grading and packing as will enable them satisfactorily to be sold upon an f. o. b. shipping point basis, to market them in such manner as to realize the full potential value obtainable under any prevailing set of general business and market conditions, and to collect and equitably distribute the proceeds. Of course cooperation can not assure the farmer a profit. In all agriculture, and especially in the production of perishables, there must be fat years and lean; and at times, as in the past summer, when the association's abnormally large output of 2,000,000 barrels of Irish potatoes was sold at an average price of about 90 cents a barrel, as against a production cost of $1.25, it has been unable to protect its members against temporary disaster. But if nation-wide business and market conditions are beyond its control, it has in large measure set local conditions in order, substituted direct and intelligent for wastefully roundabout and unorganized methods of distribution and provided the necessary business machinery for obtaining under either an adverse or a favorable state of the country's markets the full current worth of its members' goods. And, without attempting to work out in this instance the moot question of "the becauseness of the afterward," it is significant to note that during the 16 years of the association's activities and without the development of any new industries or any influx of population or any new means of transportation, the recognized markets for the peninsula's products have been expanded from a half dozen eastern cities to include the United States, Cuba, and Canada east of the Pacific slope, its production of farm crops has been nearly quadrupled in volume, the value of its farm-lands has advanced from $35 or $50 to $150 or $200 an acre, and the scale of enterprise and standards of living of its people have been commensurably increased. The exchange now markets the products of some 3,000 farmers, comprising two-thirds of the entire output of the peninsula in which it operates, and amounting in the season just closed to a total of 13,000 carloads. At each of the 45 shipping points within its territory it maintains a local agency, and to these agencies a system of private telephone lines ramifies from its general office, affording constant communication between the central selling intelligence and every source of supply.

To each shipping point, of course, from the territory tributary to it, comes the particular product being marketed, in continuous and converging streams of the carts and wagons of association members. At each shipping point these goods are received and receipted for by the local agent and inspected, classified, and combined into cars by the local inspector of the association. And between the general office and the 45 shipping points passes a constant interchange in the one direction of reports upon the prospective loading and the quantity and quality of goods actually loaded and available for sale and in the other

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of instructions as to loading and directions for the shipment of cars or smaller lots of goods of which sale has been made.

The actual business of selling is of course conducted at the general office and in charge of the general manager, whose principal duty is to supervise and direct this main activity of the association. Broadly speaking, the car lot is taken as the unit; sales are made strictly upon an f. o. b. shipping point basis; and each day the effort is made to clean up, if possible, the entire loading of that day. As all the association's products are perishable and subject to constant fluctuation in market value, all quotations are made by wire and are good for acceptance upon day of date only, each day therefore comprising a distinct selling campaign.

For the crucial matter of determining each morning the range of prices at which the exchange's goods are to be offered, recourse is had to every possible source of information as to all the factors which govern the complex problem of what prices can be obtained. Through the association's local agents and inspectors the sales force is kept constantly informed by 'phone as to the current supply available and in prospect for the next few days and of the movements and activities of the independent local buyers, who must always dispute the field with the cooperative association. Similarly, from its representatives and connections in all the important markets, constant information is received by wire as to conditions in the receiving centers. And finally, a frequent interchange of information is kept up by wire and long-distance 'phone with friendly associations and dealers in competitive producing sections. In addition to this general information, early each morning a special report is made by each local agent of the exact loading anticipated for his point that day, and telegraphic reports of market conditions as determined by actual sales are received from the association's selling agents in the near-by Eastern markets, and especially from New York, whose market is known to be a sort of barometer for the produce trade of the country at large. Thus, in the full light of complete information covering every phase of the two factors of supply and demand, determination is made afresh each morning with something approaching scientific method, if not with scientific certainty of conclusion, of the question of what prices can probably be obtained for the volume of goods to be moved before the daily fusillade of telegraphic quotations begins. The association's customer list now includes more than 1,300 produce houses in about 500 cities and towns of some 40 different States and Provinces. For conducting the telegraphic selling correspondence the entire selling territory is divided into zones, which are assigned to the several members of the general manager's staff, each to be handled, of course, under his general supervision. The item of telegraphic expense is a large one, reaching now, in spite of the constant use of a comprehensive private code compiled for the exchange's special use and distributed gratis to all its customers, an annual total of about $20,000; but it has always been the exchange's policy to use rather freely this means of effective selling.

At present probably not over 20 per cent of the association's sales are made upon quotations sent from the general office direct to individual customers. Probably 30 per cent of its sales are made through brokers, who supply the highly desirable element of representation on the spot and of personal contact with the buyer and who, as an incident of the large scale on which the exchange does business, now serve it generally for a charge of from $5 to $7 a car, as against the usual brokerage fee of $10. More important and more satisfactory still, however, approximately 50 per cent of the exchange's sales are now made through its own salaried men, sent out from its general office and stationed at

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appropriate seasons upon the markets of Boston, Chicago, Pittsburgh, Montreal, Toronto, Wilkes-Barre, Buffalo, Detroit, Cincinnati, Indianapolis, St. Louis, Minneapolis, Davenport, Kansas City, and other principal market centers. Through these outside salesmen the cost of representation is greatly less than through brokers and the representation is more personal and direct; and being exclusively employed by the association, with no other interests to promote, they serve it vastly better than the average broker in the adjustment of the occasional complaints and claims for allowances that are unavoidably incident to the marketing of perishables. All such adjustments and all collections are made by the association's secretary-treasurer, and in its firm though not too exacting insistence upon the observance of its rights and in its persistent weeding from its quoting list of all firms that refuse to take their fair losses upon declining markets or otherwise fail to show an honest regard for their obligations, the exchange has unquestionably done a big service to shippers generally and to that saving majority of produce firms that aim to deal fairly. Neither brokers nor outside salesmen, of course, have any authority to determine prices, accept offers below quotations, or effect adjustments of claims save by direction of the general office, with which they are in constant telegraphic touch.

Ninety per cent of the entire output of the association is sold f. o. b. loading point, and the remaining 10 per cent, which must be consigned to commission merchants, consists largely of odd lots and off-grade goods. These consignments are restricted to a special list of authorized selling agents in the three near-by eastern cities which are not important as markets for f. o. b. sales.

From the outset a cardinal principle of the exchange has been standardization of its products. Constantly it endeavors to maintain certain standards of culling and packing, to improve the prevalent practices in this regard, and to build up the reputation of its official stamp of approval, the now well-known Red Star brand. To this end it now spends some $30,000 annually in maintaining a force of local inspectors whose duty it is to examine a sample package taken at random from each cart or wagon load as it goes into the car; and the general inspector, who supervises and controls the work of this force, is a recognized administrative head of the business. Probably no other undertaking of the association has proved so difficult, and in no other have the results been so unsatisfyingly inadequate. Yet, measured by the utter lack of any dependable standards that formerly prevailed, the results already accomplished unquestionably mark a material and significant advance. This work of inspection demands a rare combination of firmness, tact, and patience, especially difficult of attainment on account of the semipolitical nature of any such popular organization; and since the process sought to be applied is one of popular education involving the entire membership of the association, results are necessarily gradual and slow. The exchange's experience in this field demonstrates the importance on the part of the manager of inspection of a high order of moral courage, independence of political considerations, and the capacity without friction or resentment to compel men into lines other than those of least resistance, and the necessity of absolute freedom from any local allegiance or influence on the part of the individual inspectors, who should be paid a salary rather than a commission on the goods inspected, should be frequently transferred from one loading point to another, and should be appointed by and answerable solely to the central governing body of the association.

In paying for the goods sold a separate pool is made of each day's loading, all cars of the same grade being paid for at the rate which represents the average of their actual selling prices. A commission of 5 per cent is deducted

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to cover the entire cost of marketing, and out of this the association must stand also any losses from bad accounts.

Although necessarily incorporated under the laws of Virginia as they stood at the time of its inception in the guise of an ordinary capitalistic corporation, the exchange has always been, in policy and practice, cooperative rather than profit making. For the past four years its by-laws have provided that at the end of each season, after payment of a dividend not to exceed 10 per cent upon the par value of its stock, any net proceeds remaining from the year's operations must be divided into two equal parts, of which one is added to the surplus fund, designed to enable the association's financial strength to keep pace with the growth of its business, and the other is distributed back among its members without regard to their ownership of stock, but in proportion to their respective contributions of produce. Since "members" include not only stockholders but tenants of stockholders shipping through the exchange and holders of "certificates of shipping privilege," purchasable at $1, and since the capital stock of the association is only about $40,000, as against a surplus fund of $160,000 and an annual business of $4,000,000 to $6,000,000, the non-capitalistic nature of this policy will be apparent. In 1914 the amount so refunded was $47,000; at the close of the current year (1915), after a season of unprecedented adverse market conditions, it will be nil, since the cost of the year's operations will involve a slight deficit to be made up from the surplus.

All payments for goods sold are made through the local agents, with whom the general office carries separate accounts comprehending the entire movement of produce from their respective stations, and each of whom is required to keep accounts in prescribed form with his various shippers. Prompt payment has been found to be highly essential, and to supplement its own financial resources, kept active by vigorous attention to collections, liberal borrowing from the banks is resorted to, to the end that settlement with the growers may never lag more than a week or 10 days behind the loading of their goods.

In its relations with its individual members the exchange exacts the double requirement of ungrudging confidence and of undivided allegiance. There is no haggling with the grower over prices. The association does not buy his goods, nor will it give him any guaranty in advance as to the price he will receive beyond its general undertaking at all times to use its utmost efforts to get for him the best price obtainable. Moreover, there must be no vacillating between the association and the local buyers whom it seeks to supplant, who have bitterly fought every moment of its existence, and between whom and it, by reason of a radical antagonism of aims, there can be no truce. From the beginning this requirement of constant and undivided loyalty has been insisted on as of fundamental importance. No man is permitted to split shipments or to sell to the local buyer to-day and turn his goods over to the association to be marketed to-morrow. The grower signs no contract, takes no pledge, and is absolutely at liberty to withdraw from the exchange the very moment he becomes dissatisfied; but his allegiance while it continues must be unwavering, and the first violation of the rule forbidding him to sell outside the exchange operates as a withdrawal and prevents him from making any further shipments through the association at least for the remainder of the current season.

From what has just been said the essential nature of the exchange as a militant organization, as a sort of economic welfare league for the mutual support and protection of its members, is apparent, and the question of propaganda work naturally suggests itself. At the beginning a campaign of popular agitation was organized by the leaders of the association movement and vigorously carried on throughout the early days of its struggle for existence. Later on,

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however, in the course of the tremendously rapid expansion of its business, the energies of the men entrusted with administering the association's affairs have been absorbed in the basic activity of marketing its goods, and the work of directly stimulating popular interest in the theory of the association and enthusiasm for its support has been, it is believed, too much neglected. In the inactive winter season frequent meetings are still held in the interest of the exchange. But these efforts are sporadic and are not the especial business of anybody in particular. No association journal is published, no consistent plan of propaganda work is followed, and no effort is made to organize and stimulate the missionary efforts of the local agents whose compensation on a commission basis is designed to make them solicitors for the exchange, although it would seem that these activities might with great profit be organized as a separate department, under the special management of a distinct administrative head, as part of the work of any considerable cooperative marketing association. In fact, according to the exchange's present practice, reliance is placed for support and continuing growth in membership almost solely upon the argument of results; and its continuing growth is sufficient proof that it has not only succeeded in bringing about better general market conditions (in the fruits of which, of course, its opponents as well as its members share), but that it has also been able pretty constantly from day to day to beat the prices obtainable from the local buyers, for in this respect the exchange's experience demonstrates this general principle in the art of cooperative marketing—that to secure the grower's support, or at least to retain it after his first fine indignation at the abuses from which the association seeks to rescue him has cooled, it is not sufficient to show him merely that his support of the cooperative enterprise will promote the general welfare of his community, nor even that it will make for his own ultimate well-being; he must be convinced that such support will be to his own individual and immediate advantage, or else he will be prone to "play for what's in sight" and "let George do" the cooperating. Moreover, to the impulses of the normal grower the lure of a cash payment and the concrete personal appeal of his neighbor, the local buyer, are more potent stimuli than any sense of obligation to the great body of his fellows or any abstract loyalty to the altruistic principle of cooperation; and though it have every moral claim to the grower's support, yet to survive the association must not only equal but day by day must beat the prices which the local buyer will offer.

Of this cursory study it remains only to consider the general government of the association. Though purely cooperative in policy and practice, it has never been in theory democratic, for in the general annual meetings of its stockholders and in the election of its general board of directors, chosen separately as the representatives of its 36 "local divisions," voting is by shares and not by persons. Fortunately, a preponderance of the stock and consequently a predominance in voting power remains in the hands of the small stockholder, and there has never been any ghost of a pretext for charging that the association's affairs were administered in the interest of a privileged class. The theoretical inequality involved, however, has always been repugnant to the innate sentiments of the members at large, and five years ago this feeling was made the basis of a revolt that threatened utterly to destroy the association. It is notorious that the cooperative associations which perish are not destroyed by outside forces; they blow up from within. In 1910, a lean year of adverse general market conditions and inevitable low prices brought about a feeling of general dissatisfaction, and the exchange and its management, as the most conspicuous target within sight, gradually became the object of the crowd's

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unreasoning resentment. Of course the few designing office seekers necessary to give stimulus and leadership to the forces of discontent were not lacking; all sorts of wild charges of corruption in the management and oppression of the farmer were originated and in the growing excitement gathered force without any necessity of substantiation.

In the face of a clamorous demand for voting reform the founders and leaders of the cooperative movement, becoming alarmed, clung tenaciously to the old conservative plan of voting as the exchange's only hope of being saved from destruction. The annual meeting broke up in a riot and was with great difficulty and imminent danger of violence carried after a month's adjournment to a perfunctory conclusion; and amid the most intense excitement and partisan bitterness some two-fifths of the exchange's members withdrew and joined with its former chief enemies to form an antagonistic organization. Of this organization one avowed purpose was to destroy the so-called "old exchange"; and for its general manager was chosen a leading local buyer, who had been for years the bitterest enemy of cooperation on the peninsula. Its inspiration seemed to be largely a sort of spontaneous socialism of the crowd, and its platform of proposed reforms included all the wild and impractical schemes that might be expected from the heat and bitterness in which the whole movement had been suddenly engendered. Unquestionably the rank and file of its membership were actuated by a thoroughly honest, if unreasoning and largely artificial, sense of grievance; and they stood by it through two full years of ruinous losses with a loyalty from which the older organization may well take to itself a lesson. Disappointment and ultimate dissolution were inevitable, however; the crowd's hastily conceived schemes for bringing about the farmers' economic millennium would not work; disaster followed disaster, imposing upon the individual members an enormous burden of sacrificed values and of goods entirely unaccounted for; and at the end of the second season only the bare shell of a corporate existence and a hopeless accumulation of debts remained.

To-day—five years since its inception—the new movement is only the sorest of memories, galvanized still at times into fresh painfulness in connection with its long-drawn-out bankruptcy proceedings by some fitful proceeding to subject to the claims of creditors a bunch of accommodation notes or a multitude of small stock subscriptions; while the "old exchange," having persistently followed along its original lines of sound cooperative endeavor and its argument of results, has gradually regained the numbers and confidence of its lost membership and stands now apparently more firmly established than ever before. For democracy, while in all human affairs the most desirable of states, is yet not an absolute blessing, but rather a strong potion, which, in matters of cooperative endeavor as of government, must be administered to every people only in proportion to its strength to receive it. And yet the writer—a heretic, perhaps, standing unorthodox in the temple—if only for the glory of the experiment and the bright possibility of its success, would far rather have seen the individual members of the union endowed from the outset with an equal voice and responsibility for its control.

The CHAIRMAN. The papers which have been read this afternoon are now open for discussion.

Mr. WATERS. In regard to the increase of carrying capacity of the ranges under better management, a point brought out in the paper by Mr. Potter, the statement was made, I think, that the present combined capacity of the ranges was about 50 per cent greater than

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10 years ago. Does that mean that they were or were not stocked to their limit at that time, and is there an actual increase in the carrying capacity of the range or different methods of stocking?

Mr. POTTER. It is both. It is an improvement in the condition of the ranges at the time they were included in the national forests and the opening up of new ranges. It is impossible to say what part of the 50 per cent increase is due to the improvements of those ranges or to the opening up of new ranges. It is a little of both.

Mr. WATERS. What is the possible future expansion of the business, or what other increase may be made in the carrying capacity of the ranges, broadly speaking?

Mr. POTTER. A carrying out of the plan which has been adopted and the use of the information which we have gained by our experiments will add anywhere from 15 to 20 per cent.

Mr. WATERS. Now let me ask another question: With the keeping down of the forest fires, in the southwestern country particularly, and the consequent growth of mesquite brush, what is going to be the result when those pastures become completely covered with mesquite brush, as some or many of them are now rapidly approaching?

Mr. POTTER. It will mean the elimination of grazing. That is one of the problems we are face to face with now—that is, a practical way of keeping down the brush on areas which could be used for grazing. It may be possible that we will have to resort to burning some of those brush areas which are not needed to produce trees in order to preserve them for their grazing value.

Mr. WATERS. In many of those regions the ground is covered with brush, and the brush is too large to kill by burning. It will cost more than the land is worth to clear it off; and what is to be done?

Mr. POTTER. That is a problem, of course. If it can not be burned or cleared away with profit, the brush must be removed in some manner so as to preserve the full grazing value of the land. Just how that can be done is, of course, hard to say, but the brush must be removed at a cost which will make it pay.

Mr. WATERS. Is the increase of the brush on the ranges sufficient in amount to be an important factor in this whole question?

Mr. POTTER. I do not think it is. It is an important factor only in limited area in some of the localities, but, on the whole, it will not cut any great figure in the meat supply of the country.

Mr. MARSHALL. I would like to ask one question in reference to Mr. Potter's subject. First, let me precede the question by a statement of fact. There are in this country 290,000,000 acres of unreserved, unappropriated timber, regarding which there is no governmental policy and which chiefly western stockmen are using by agreement, largely, illegally. I do not believe it is generally realized

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how much of a problem that is, and how much importance it has for the country as a whole. Those lands have been held up supposedly for homesteaders, while they are, as a matter of fact, being used in an illegal way for stock raising. I just referred to that as a public question which has never been solved, and on which no legislation has been enacted nor attempt made to enact, looking toward giving the men who are now occupying that land some definite tenure. I think it is well recognized that some definite tenure, by which they can use those lands, is desirable. If we agree as to the desirability of the definite term of tenure for grazing land for other than the summer grazing, as to the frequency of the renewal of the terms in the forests where much of the summer grazing is done, what should be the status of that permit?

Mr. POTTER. Most of the permits on the national forest are annual. We have a provision where, if the stockmen desire, we will arrange for them five-year terms, which may be issued. Those permits may be renewed for five years. There is not a great demand for the term permits on the national forests, however, for the reason that under our regulations the stockmen feel sure that if they obey the regulations their permits will be renewed the following year except so far as it may be necessary to reduce them to take care of new settlers coming in. In the extension of that system to the public grazing lands which are now under the control of the Government, I would say, in many localities in order to encourage the stockmen to make the necessary expenditures that would be required in water development and construction of fences, probably a tenure extension should be given, but I do not think a tenure should be granted for a period longer than 10 years. In Australia I understand they do have a tenure of 28 years, but I do not believe it would be necessary in this country.

The CHAIRMAN. Is there any further discussion on any paper? If not, then this joint session will be declared adjourned.

Adjourned at 4.50 o'clock.

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## JOINT SESSION OF SUBSECTIONS 2, 4, 5, AND 6 OF SECTION III AND SUBSECTION 8 OF SECTION IV.

RALEIGH HOTEL,
*Friday morning, December 31, 1915.*

Chairman, A. C. TRUE.

The session was called to order at 10 o'clock by the chairman.

Papers presented:

Phytotechnic studies and agricultural experiments in La Estanzuela, Uruguay, by Alberto Boerger.

The progress of agricultural science in Cuba, by J. T. Crawley.

Extension education, by Kenyon L. Butterfield.

The interdependence of forest conservation and forestry education, by J. W. Toumey, Yale University.

The CHAIRMAN. We are to take up this morning certain matters relating to education and experimental work. The section on education has already discussed at its meetings the college work in agriculture in a general way, and we are to take up this morning some special features of that work. I take great pleasure in introducing Prof. J. W. Toumey, of the Yale University School of Forestry, who will speak to us on the subject of "Education in forestry."

Mr. TOUMEY. Mr. Chairman, and members of the congress, this paper which I have prepared really deals with the interrelations of forest conservation and forestry education.

### INTERDEPENDENCE OF FOREST CONSERVATION AND FORESTRY EDUCATION.

By J. W. TOUMEY,
*Director, School of Forestry, Yale University.*

The economic and industrial development of the Western Continent is comparatively recent. The abundance of the natural resources in the New World made the consideration of their exhaustion a subject of little public interest. The increasing rapidity in the depletion of these resources, particularly in the most populous and best industrially developed of the American Republics, has within recent years emphasized the need of foresight in dealing with them.



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The United States has been the foremost of the western nations in urging the conservation of natural resources through better use and in enacting national and State laws regulating use. When a nation is new and sparsely populated the necessary encouragement for industrial expansion and increased population makes governmental regulation of forest and other natural resources less essential. There comes a time, however, in the life of every nation when future needs must be safeguarded from present private greed. When this time comes a change must be initiated in the method of handling these resources.

The recognition of this principle caused the United States in 1891 radically to change her policy regarding the unoccupied national domain and begin the establishment and organization of national forests. Prior to this time practically all of the forests in the entire country could be exploited without regard for a second crop, because nearly all timberland was privately owned or else in the public domain open to sale or settlement. Fortunately, in the United States, when the policy of the public ownership of forest property was accepted, there were still large areas of public domain covered with timber from which national forests could be segregated without cost to the Republic. Unfortunately, these areas were chiefly in the western half of the country, consequently the national forests are, for the most part, located in the States west of the Mississippi River and remote from the best timber markets.

It is invariably the case that nations do not awaken to the need for forest conservation until too late to attain the best results without large expenditures of time and money. Thus, the United States in order to secure national forests in the eastern half of the country, where there is the greatest need for forest conservation and the orderly development of forest property, is forced to purchase from private owners timberland that never should have passed from public ownership.

The segregation of the national forests from the public domain during the past two decades has given us 162 national forests, having a total area of nearly 165,000,000 acres. The more recent policy of purchasing timberland from private owners for national forests in the East has already resulted in the acquiring of nearly 386,000 acres in seven of the Eastern States. About 900,000 acres additional have been approved for purchase. The fixed policy of the Government relating to the management of the vast acreage in national forests is conservation through use—i. e., the treatment of the property so that the yield will increase rather than decrease with use.

During the same period that the National Government has been creating, organizing, and developing national forests the State governments have been creating, organizing, and developing State forests. At the present time 14 States have a total of 147 State forests, which embrace an area of nearly 3,675,000 acres. New York, with two large State forests of 1,825,882 acres, leads all other States in the extent of her State-owned forests. Pennsylvania, with 50 State forests of nearly 1,000,000 acres, has done much more than the other States in the organization and development of them.

Counties, cities, and towns have secured, chiefly within the past decade, communal forests varying from less than 100 acres in extent to more than 20,000 acres. Complete data relating to communal forests in the United States is not available. The States having the largest number of such forests are Massachusetts and New York. It is believed that there are, at the present time, from 200,000 to 300,000 acres of communal forests in the United States. These forests have, for the most part, been acquired for the purpose of protecting the

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watersheds from which potable water is obtained for the use of cities and towns. They are usually located in the vicinity of large centers of population where there is a demand for all classes of forest products, thus making the practice of intensive forestry possible.

The most interesting and far-reaching movement in forestry in the United States has been this movement toward public ownership of forest property. Approximately one-fifth of the total area of the forests in the United States has been made into national, State, and communal forests in the space of 20 years. The public has squarely faced the issue of forest conservation and has recognized the fact that it is not possible without the public ownership of forest property. Our forest policy is firmly anchored on the rock of public ownership that our forest resources can be made to continue indefinitely and not become waning resources when increased population and industrial development make their need even more important than at the present time.

Four-fifths of all the forests of the country are still in private holdings. They are in small holdings attached to farms or in larger holdings in non-agricultural regions. The larger holdings contain more than three-fifths of all the merchantable timber in the entire country. They are in the possession of individuals or corporations that have consolidated and brought together these large holdings in comparatively recent years, often at a large initial cost. This enormous body of virgin timber, because of the large carrying charges for interest, taxes and protection, must, from necessity, be forced on the market as rapidly as possible. This accounts for the small increase in stumpage values during recent years.

The quantity of standing timber in the hands of private owners is so large, the competition for a market is so keen, and the necessity for cutting is so imperative that there is little likelihood of a marked advance in stumpage for many years to come. The inevitable result of this condition is the utter inability of the owners of more than three-fifths of the merchantable timber to cut their stumpage in a manner that will insure a satisfactory second crop. The practice of forestry necessarily carries with it present expenditures far beyond those incurred in forest exploitation without regard for future crops. Only a small percentage of the private forests in the United States are so favorably located in reference to market that the value of all classes of stumpage is sufficiently high to make thinnings, reproduction cuttings, plantings, and other operations concerned with the production of the crop profitable. For this reason forestry is not practiced by private owners of timberland except on woodlots in strictly agricultural regions and in restricted areas of New England and elsewhere where there is an excellent local market for all classes of forest products.

Although in most cases the private owner can ill afford the present expenditures necessary to insure future crops and will not make them, the public can well afford to make such expenditures, and experience shows that it does make them. Thus, the administration of the national forests is spending on them nearly twice the present annual receipts. The public can well afford to make present expenditures in order to insure future crops of timber because it is not only recompensed from the timber produced but also by the indirect value of the forest to the entire community. We should clearly appreciate the following fundamental truth. It is the indirect value of the forest which accrues to the public at large that makes the practice of forestry economically possible by the public before it is possible by the private individual. The public can and should practice forestry, while the private individual seldom can economically, and will not. I therefore affirm that the practice of forestry in the

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United States really began with the creation of public forests. Its progress will be measured by the increase in area of such forests and the rapidity with which they are organized and developed.

With this brief outline of our advance toward forest conservation, I now direct your attention to the intimate relation that forestry education bears to it. Forestry education was the fountain head from which sprang the beginnings of forestry in this country. Forestry education is the source from which flows all progress in forestry. It shapes and directs our forest policy and determines our methods of practice. Forestry education and forest conservation have moved forward together. Without the one the other would be impossible.

Forestry education began in the United States more than a century ago, but not in schools. It began with the first desultory efforts of a few far-seeing enthusiasts, who had a clear vision of the future, to interest the public in forest conservation. Little progress, however, was made until the early eighties when more systematic propaganda was undertaken. A forest commissioner was appointed by the United States Department of Agriculture. The importance of this office has steadily grown. In 1886 it became the Division of Forestry, in 1901 the Bureau of Forestry, and in 1905 the Forest Service. Practically all of the early work of this branch of the Government service was educational in character—viz., systematic propaganda showing the need for forest conservation. Great assistance in this important movement was given in 1882 through the formation of the American Forestry Congress, which later became the American Forestry Association. The proceedings of this society contain the complete history of the progress in establishing our present forest policy. Its journal, American Forestry, has been a leading force in shaping public opinion favorable to forest conservation. Forestry commissioners were appointed in various States in rapid succession, and State and local forestry associations were formed.

All of the above forces working together so shaped public opinion that it became possible to enact legislation in 1891 making the public ownership of forests possible. Prior to this date New York and a few other States had begun the establishment of State and communal forests, but purely for the purpose of protection, recreation, and sport. Up to this time forest conservation in the United States was not in the woods. It was chiefly educational propaganda—the shaping of public opinion in the desire for forest conservation. National forests were established in rapid succession after the above date. Many States began or continued the policy of acquiring forest property for State forests; and later, here and there throughout the country, but particularly in the East, counties, cities, and towns began to acquire adjacent lands for communal forests.

The establishment of public forests has gone on until at the present time approximately one-fifth of the forests in the United States are public forests, to be held for the production of timber and for protective purposes. During the long period of propaganda leading to the approval of, and the desire for, the public ownership of forest property in the United States, the burden of developing public opinion favorable to forest conservation fell upon the shoulders of a small number of men who were willing to contribute their time and money toward what they believed to be a great and pressing public need. As time passed this small group grew into a vast army, and public opinion favorable to forestry was the inevitable result. It is the writer's belief that no Republic can reach even the beginning of forest conservation unless some

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of her citizens recognize the need and are willing to sacrifice their time and money for this public necessity.

I purposely place great emphasis upon the period of educational propaganda because without it our remarkable development in forestry during the past 24 years would have been impossible. A great constructive movement in forestry can not be initiated in a republic without the people solidly behind it. Our constructive work of the past two and a half decades rests upon years of organized educational propaganda. Our sister Republics in their efforts to place forestry upon a sound foundation must build the foundation out of public desire. Organized educational propaganda in the hands of national and local forestry associations, propagandist journals, and efficient press bureaus are the great forces in creating a public opinion favorable to forest conservation. When public desire has been created the practice of forestry becomes possible. It is not porsible earlier.

Although educational propaganda favorable to forestry began in the United States more than a century ago, technical training in the science and art of forestry had its beginnings within the past two decades. The first professional forest school was established at Cornell University in 1898. Two years later a professional forest school was established at Yale University. During the following decade and a half more than 20 schools or departments of forestry, offering professional training and a degree in forestry after the completion of a prescribed course, were established in various parts of the country, either as separate institutions or as departments of existing universities and colleges.

The question naturally arises, Why was technical training in forestry so long delayed and why has it met with such extraordinary expansion in the short space of 17 years? The answer is found in the bringing of approximately 20 per cent of all the forests of the United States under public ownership.

The establishment of public forests carried with it the necessity for their management and orderly development. This could not be attained without men trained in the science and art of forestry. The segregation of 162 national forests from the unoccupied public domain, having an average area of more than 1,000,000 acres each, within the space of 20 years has in itself called for the services of hundreds of technically trained men and will call for many more men with the gradual increase in the intensity of management. The schools arose to supply this demand for trained men. There was no demand for professional schools until public ownership of forest property became the keystone in our forest policy, and there would be but little demand now were this keystone removed. Our whole structure of forest conservation, of forestry education, of forestry practice rests upon the public ownership of forests. The economic situation relating to private forest property is such that, in the main, exploitation rather than forestry will be the basis for operation for many years to come. Pull down the keystone of public ownership and the splendid structure that has been erected with its great National Forest Service and the forest service of the several States will crumble, cobwebs will cover the windows of our professional forest schools, and the dark ages of forest conservation will again prevail. The keystone must not be removed.

It is believed that public opinion will not waver from the task that it has set, but will strengthen as time goes on until at least 50 per cent of the strictly non-agricultural lands capable of producing forest crops is publicly owned, until at least this amount of our absolute forest land is back in the hands of the public who made the great economic mistake years ago of disposing of it and subjecting it to unregulated exploitation. If this optimistic view of

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forestry in the United States prevails, the efficiency and power of our forest schools will increase and they will gradually adjust themselves more closely than at present to the needs of the country.

The remarkable increase in agricultural research and education in the United States during the past half century has profoundly influenced agricultural production. The vast sums spent annually by the Nation, the States, and lesser governmental units are returned a hundredfold by increased and diversified production. Our large number of agricultural colleges and experiment stations are living monuments to the public belief that the conservation of agriculture rests squarely upon the educational forces that direct and shape its progress. Our forest schools and research stations are just as essential in our scheme of education if the practice of forestry becomes a part of our national development and the future growth of forest crops adequate for our needs.

The superior position of Germany in forest conservation, whereby she produces nearly all of her wood requirements without lessening her forest capital through overcutting, is due to her many long-established forest academies and other institutions, where hundreds of young men are trained in the production and utilization of forest crops and in the principles which underlie a sound and economic forest policy. Her technical forestry education has been of slow but progressive growth, beginning with the "master schools" of Zanther, Hartig, and Cotta nearly a century and a half ago. Each of these forest managers surrounded himself with young men and taught them the principles of forest practice on the forests under his charge. This early work gradually grew into the present educational system with the many forest academies and other institutions for the training of men in the science and art of forestry. The gradual development of forestry education in Germany has resulted in a healthy growth and has moved in the direction most useful for the needs of that country.

A similar development of forestry education in the United States was impossible, due to the establishment of more than 165,000,000 acres of public forests in less than two decades, all awaiting organization and orderly development for which the public was willing to pay. Hundreds of trained men were wanted at once to assume responsible positions as district chiefs, inspectors, investigators, and supervisors. This call for a large number of professionally trained men at one time has resulted in a remarkable growth in forestry education in the United States.

Forestry education in the Old World has developed around two general types of schools—viz., the university schools and the better type of forest academies, which are strictly professional in their training, and the ranger or practice schools, which are vocational in training. The former are scientific, and the preparatory and technical courses are equivalent to five or six years of collegiate work in this country. The latter are primarily concerned with the recognized art of forestry in the particular region where the men are trained to practice. The course is usually but one or two years in duration and is based upon a common school education. The men trained in the first of these two classes of schools after a year or more of apprenticeship under a practicing forester are in line for gradual promotions to the highest positions which the profession has to offer. The men trained in the second are equipped for the vocation of ranger, woods foreman, and similar positions concerned with the oversight of labor in producing and harvesting the forest. The purpose of the latter school is entirely different from that of the former. Its aim is to train men for subordinate positions.



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In the organization and orderly development of forest property there is need for many more men trained in the vocational schools than there is for men trained in the professional schools. In forestry scores of foremen, guards, and rangers are necessary for every professionally trained forester. Where one man trained in the science of forestry will find a position suitable to his attainments many men vocationally trained in the local art will find work.

A hard and fast line can not be drawn in this country between these two classes of schools, although in the main there has been an abnormal development of the professional schools and an underdevelopment of the vocational schools. The reason for this one-sided development of forestry education in the United States is found in the demand for professionally trained men in the decade between 1902 and 1912, which is the period during which nearly all the professional schools were established. The transfer of the national forests to the Department of Agriculture in 1904 and their organization under the Forest Service created positions for a large number of trained men. During the same period a rapidly increasing demand for professionally trained foresters was created through the establishment of departments of forestry in many States. All of these positions, with the possibility of rapid promotion, were highly attractive to college men. How rapidly the educational machinery of the country responded to this demand for technical training is shown in the number of schools now offering degrees in forestry and the facilities for technical training that are in the process of development.

The following is a list of the institutions in the United States that offer technical courses in forestry leading to a collegiate degree. This list shows the number of degrees granted by each institution prior to December, 1915, and the number of graduates actually employed in the profession in April of the same year.

| Institution. | Number of degrees granted prior to December, 1915. | Number of graduates engaged in forestry, April, 1915. |
|---|---|---|
| Colorado College School of Forestry | 10 F. E. | |
| | 1 M. F. | 8 |
| Colorado Agricultural College | 4 B. S. F. | 3 |
| Cornell University | 17 F. E. | |
| | 16 B. S. F. | 35 |
| | 11 M. F. | |
| University of California | | |
| Georgia State College of Agriculture | 3 B. S. F. | |
| Harvard University | 53 M. F. | 50 |
| University of Idaho | 8 B. S. F. | |
| | 1 M. F. | 5 |
| Iowa State College | 37 B. S. F. | 25 |
| University of Maine | 50 B. S. F. | 30 |
| Michigan Agricultural College | 97 B. S. F. | 48 |
| University of Michigan | 103 M. S. F. | 71 |
| University of Minnesota | 83 B. S. F. | |
| | 1 M. S. | 63 |
| University of Missouri | 6 B. S. F. | 2 |
| University of Montana | 1 B. S. | |
| University of Nebraska | 60 B. S. F. | |
| | 1 M. F. | 46 |
| Ohio State University | 80 B. S. F. | 47 |
| Oregon Agricultural College | 28 B. S. F. | 16 |
| Pennsylvania State College | 106 B. S. F. | 68 |
| Syracuse University | 31 B. S. F. | |
| | 4 M. F. | 11 |
| State College of Washington | 2 B. S. F. | |
| University of Washington | 22 B. S. F. | |
| | 5 M. S. F. | 22 |
| Yale University | 340 M. F. | 253 |
| Total | 1,185 | 803 |

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It appears from this table that 1,185 men have been granted degrees in forestry since the first degree was given by Cornell University in 1900, or in the space of 15 years. About one-half of the degrees granted have been undergraduate degrees given for four years of collegiate work, often, however, with a comparatively small proportion of work in the scientific branches of technical forestry. Advanced degrees in forestry are offered by 10 institutions. These schools have better faculties, more mature and experienced instructors and are better equipped for instruction in both the science and art of forestry.

In April, 1915, out of 1,037 men who had then received degrees 803 were reported as actually engaged in forestry. The tremendous influence of the United States Forest Service in shaping forestry education in this country is shown in the fact that from 1899 to 1915 there were 591 forest assistants appointed to that service, as shown in the table below. Of this number, 273 were appointed through competitive examinations from among the graduates of a single professional school. The position of forest assistant is the lowest technical position in the service, and new appointments to this position are determined by civil-service examinatons.

*Forest assistants appointed in the United States Forest Service for the period between 1899 and 1915, inclusive.*

| | | | |
|---|---|---|---|
| 1899 | 2 | 1909 | 48 |
| 1900 | 2 | 1910 | 73 |
| 1901 | 8 | 1911 | 72 |
| 1902 | 13 | 1912 | 72 |
| 1903 | 19 | 1913 | 31 |
| 1904 | 42 | 1914 | 26 |
| 1905 | 57 | 1915 | 9 |
| 1906 | 35 | | |
| 1907 | 30 | Total | 591 |
| 1908 | 52 | | |

The universities and colleges in the United States that offer professional training in forestry granted degrees to 147 men in June, 1915. From the number of men now attending courses in forestry in these institutions it appears that a larger number will complete their training in 1916 and a still larger number in 1917. Three years ago 72 forest assistants entered the National Forest Service under civil-service appointments. Since then the number of appointments has decreased with startling rapidity. Only nine appointments to the position of forest assistant through civil-service examinations were made in 1915. From 1900 to 1910 the number of yearly appointments increased from 2 to 73. It was during this period that the many schools arose and secured equipment and faculties to supply this rapidly increasing demand for professionally trained men. Although the schools are far better equipped than formerly, the rapidly decreasing demand in the public service, due primarily to the completion of the preliminary organization of the public forests, is forcing nearly all of the graduates in forestry during 1915 to seek employment in the forests under private ownership or to find places on the public forests that are also open to those without a professional training, hoping to be promoted to better positions later on. From now onward, the annual appointment of technically trained men to new positions in forestry under the national, State, and lesser governmental units depends upon the rapidity with which additional public forests are established and upon the subdivision of present public forests into smaller and more intensively managed units.

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The permanent laborers employed in our public forests, including those holding the position of guards and rangers, are usually recruited from among residents of the States where the forests are located and from men wholly without technical training but with a more or less intimate knowledge of local conditions. The examination required is not technical in character. These men are employed in large numbers and at first are, without doubt, more useful than professionally trained men unfamiliar with the locality and conditions when employed at what is ordinarily considered guard or ranger work. From amongst this army of men without professional training many are later promoted to the position of supervisor and to other places in the higher branches of the service. These promotions are made without further examinations. There is no doubt but that qualities that lie wholly outside of technical efficiency are of fundamental importance in the appointment to the lower places in public forestry and in later promotion. When these other qualities are acceptable, however, appointment and promotion should center upon thorough technical preparation, upon an intimate knowledge of the science of forestry which can seldom be obtained except by a number of years of systematic training.

Rule of thumb methods picked up in the woods seldom prepare a man for justifiable promotion to positions that deal with the organization and orderly development of forest property. Were this fundamental distinction between technical training and woods experience adequately appreciated in promotion, the college man with technical training could better afford at the outset of his professional career to take his place with ax and saw by the side of his non-technical competitor.

The largest present field for men immediately after completing their professional training is in private work, but here a man must prove his worth before he is given more than a workman's wage. Although four-fifths of our forests are privately owned, the economic conditions that control timber prices are such that professionally trained men can rarely be employed under adequate salary, and money can seldom be expended for the sole purpose of employing scientific methods in the production of forest crops. When employed, their work must deal with methods of better and closer utilization rather than forest production. Although this field is unlimited for professionally trained men who are willing to begin at the bottom and offers the highest financial prizes for those having the requisite qualifications, the qualifications based upon full professional training are secondary to other more fundamental ones which, combined, form business efficiency and business sense.

Although full professional training is essential in National, State, and communal forestry where present expenditures are possible through public appropriations for the organization and orderly development of the forest, I seriously question whether at present it can find adequate scope in private forestry, because the organization and orderly development of the privately owned forest can seldom be attempted under present economic conditions. What private forestry in the United States needs is more vocational training and less professional training. A few instead of many strong professional schools, well equipped for both teaching and research, whose graduates can find adequate scope for their attainments, should rest upon a much broader foundation of public and vocational training in forestry than we have at the present time. It is the duty of these schools to lead in forestry investigation, the publication of technical books on forestry, and the support of technical journals.

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Agriculture and forestry have close kinship. They both have to do with the production, harvesting, and marketing of crops grown from the soil. They differ chiefly in the time required for the crop to mature. Why should we not have State, county, and town institutes that impart public instruction in forestry as well as in agriculture? Why should we not have instruction in forestry in certain high schools and other institutions as we now have in agriculture? Why should we not have field demonstrations for the public in forestry as well as in agriculture? Not only have we, in our heroic efforts to erect many professional forest schools, been negligent in supplying the machinery for educating the public in the scientific treatment of woodlands, but we have been equally negligent in supplying the machinery for vocational training. Although more than 50 institutions in the United States have within the past 15 years developed more or less work in forestry education below the grade of full professional training, it has largely been without definite aim and has been poorly suited to the real needs of the country. Very little of it even approaches the requirements of the ideal vocational school. As reported by the committee on forestry education at the Fifth National Conservation Congress:

> The vocational forest school should bear the same relation to professional training that the wood shop bears to research in technology or the business school to university instruction in economics and commerce. It is analogous to the trade schools or a system of apprentice training whereby men are equipped for the skilled trades. The vocational school must, therefore, aim to teach the art or trade of forest practice, not the science of forestry.

In order best to serve the purposes of forestry education in the United States at least two-thirds of the money now expended on professional training could be better spent in the instruction of the public through the organization of institutes, field demonstrations, and similar methods that have been found so effective in agriculture and in the organization of vocational schools for the training of young men in the art of forestry practice.

What does the experience of the United States in forest conservation and in the development of forestry education teach that can be useful to her sister Republics? The writer believes that it teaches the following fundamental truths:

1. The possibility of forest conservation in any Republic which has for its foundation the orderly development of forest property and a sustained yield, rests squarely upon organized propaganda which has for its purpose the creation of public opinion favorable to forestry—a public opinion that is willing to make present expenditures for future welfare.

2. The keystone in organized propaganda must be centralized in public ownership—i. e., absolute forest lands must, so far as present economic conditions permit, be owned by the public and managed by and for the public.

3. Organized propaganda must continue as an indispensable part of forestry education, even after the beginning of forest conservation has been effected through public ownership. A strong public sentiment favorable to forest conservation is the only effective weapon for keeping public forests from exploitation by those who consider public property their just prey and await every opportunity to pounce upon it.

4. Forestry education beyond that attainable by organized propaganda for the purpose of molding public opinion should result in putting the actual practice of forestry into operation upon both public and private forests to the fullest degree in accordance with economic conditions. It can attain this end only by welding together and giving emphasis to each of the following:

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(*a*) Forestry education when the training is secondary to other work.
(*b*) Vocational training in forestry.
(*c*) Professional training in forestry.

The overstimulation of professional training whereby a much larger number of men of high educational attainments and thorough technical preparation are trained than are able to find professional employment is a waste and detriment to forest conservation. On the other hand, secondary and vocational training can scarcely be overstimulated. It is the writer's opinion that the progress made in the actual conduct of forestry operations in the woods must center in a vast army with some training rather than full professional training, whose knowledge of forestry is chiefly confined to the art of forestry so far as it concerns their own locality and who do not look for, and should not expect, a wage beyond that which the operations justify.

BIBLIOGRAPHY OF FORESTRY EDUCATION IN THE UNITED STATES.

Northrop, B. G. The schools of forestry and industrial schools of Europe. New York, 1878.

———. Tree planting and schools of forestry in Europe. New York, 1879.

Barrett, J. O. Forestry in our schools. Minneapolis, 1895.

United States Department of Agriculture. Schools of forestry. U. S. Dept. of Agriculture Yearbook, 1899–1905.

Price, O. W. Study in Europe for American forest students. (The Forester, 1901, vol. 7, pp. 38–41.)

Woolsey, T. S. European study for foresters. (Forestry and Irrigation, 1905, vol. 11, pp. 160–163.)

Winston, G. T. Education in forestry in the public schools and colleges. (Forestry and Irrigation, 1906, vol. 12, pp. 40–41.)

Green, S. B. Forestry education and experimentation in the agricultural colleges and experiment stations. (Forestry and Irrigation, 1906, vol. 12, pp. 30–32.)

Graves, H. S. Some problems in forest education. (Proceedings of the Society of American Foresters, 1907, vol. 2, pp. 48–62.)

United State Department of Agriculture. Forestry in nature study. U. S. Dept. of Agriculture, Office of Experiment Stations, Washington, 1909.

Fernow, B. E. Public responsibility of the forest schools. (Forestry Quarterly, 1910, vol. 8, pp. 26–30.)

Graves, H. S. The aim and organization of the professional forest school. (Forestry Quarterly, 1910, vol. 8, pp. 1–11.)

Roth, F. The curriculum in forestry education. (Forestry Quarterly, 1910, vol. 8, pp. 17–18.)

Smith, H. A. The place of forestry in general education. (Forestry Quarterly, 1910, vol. 8, pp. 191–195.)

Ellis, C. The place of forestry in the schools. (American Forestry, 1911, vol. 17, pp. 509–514.)

Graves, H. S. Conference of forest schools, Washington, 1911. Report of the committee on standardization of instruction in forestry (n. p., 1912).

Baker, H. P. Some needs in forestry education. (Forestry Quarterly, 1912, vol. 10, pp. 45–49.)

Burden, E. R. Report on a visit to the United States and Canada for the purpose of studying the research work and educational methods of the forest departments and forestry schools. Cambridge, 1912.

Detwiler, S. B. Teaching students how to conserve energy. (Forestry Quarterly, 1912, vol. 10, pp. 402–406.)

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Graves, H. S. Ranger schools. (Forestry Quarterly, 1912, vol. 10, pp.. 395–398.)

Baker, H. P. Value of physics and other fundamental subjects to students in forestry. (Forestry Quarterly, 1913, vol. 11, pp. 395–398.)

Toumey, J. W. Report of subcommittee on forestry education. Fifth national conservation congress. Washington, 1913.

———. The training in forestry during the next decade. (Proceedings at the opening of the forestry building, Cornell University, May 15, 1914.)

The CHAIRMAN. The next paper on the program is entitled "Phytotechnic studies and agricultural experiments in La Estanzuela, Uruguay," by Dr. Alberto Boerger, director of the experiment station. I am informed that Dr. Boerger is not present, but his paper will be read by Mr. Sutton.

## TRABAJOS FITOTÉCNICOS Y DE EXPERIMENTACIÓN AGRÍCOLA EN "LA ESTANZUELA," REPÚBLICA ORIENTAL DEL URUGUAY.

Por ALBERTO BOERGER,

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### I. DATOS GENERALES.

La materia, indicada en el epígrafe, es tan vasta y amplia que sería fácil escribir desde luego algunos libros sobre los trabajos efectuados por el informante durante 3½ años de estadía en el Uruguay.

Pero, tratándose en todos estos trabajos de "experimentos," propiamente dichos, hay que tener en cuenta lo que caracteriza a cada experimento científico. Ni en el viejo continente de Europa con sus innumerables institutos de investigación y experimentación agrícola, donde cerebros disciplinados y bien instruídos manejan desde hace decenios en forma modelo todos los medios y útiles modernos de tal experimentación, se ha encontrado la única última fórmula que debe reinar en los esfuerzos del hombre, tendientes a descubrir y dominar los secretos de la naturaleza en cuanto a la transformación de materia inorgánica en orgánica por intermedio de las plantas agrícolas como "máquinas" y la energía solar como "fuerza motriz" en la usina terrestre del universo, cuyo obrero noble desde los tiempos prehistóricos sigue siendo el agricultor. Y sigue interesándose cada vez más—una vez establecida la ley pesimista del Malthusianismo—toda la gente, tanto del viejo mundo europeo como también del nuevo, americano, por los métodos de hacer trabajar por el obrero-"agricultor" dichas máquinas—"plantas," á fin de producir con el mínimum de trabajo el máximum de materia orgánica.

Vamos así a reseñar a grandes rasgos, lo que en este renglón ha hecho hasta hoy día la República Oriental del Uruguay, habiéndose creado "Estaciones Agronómicas" para coadyuvar en la solución de los problemas mencionados, siguiendo el ejemplo de casi todos los países civilizados del mundo. No me corresponde aquí pronunciar un panegírico de las Estaciones Agronómicas en general, ni de los fines que ellas buscan. Tengo que hablar solamente de la experimentación y de los trabajos científicos, efectuados en el establecimiento a mi cargo, el Semillero Nacional "La Estanzuela" y reanudando el hilo intro-

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ductor de más arriba, debo decir que hay que concretarse por el momento en una descripción de lo poco que existe hoy en día al respecto en el Uruguay, haciendo a la vez vislumbrar las perspectivas halagüeñas de todos los trabajos encaminados para un futuro no tan lejano. Y mientras no sea aún la obra iniciada recientemente aquí en el Uruguay coronada por el completo éxito triunfal, sigamos siendo buenos y verdaderos adeptos de la ciencia, "repitiendo, comparando, transformando, manoseando y estudiando" los problemas establecidos bajo todas formas de modificaciones y aspectos nuevos. El estudio paciente y sucesivo tendrá que darnos así la llave de la misma única y última ley de la naturaleza que se ha descubierto ya en tantas otras manifestaciones de la vida natural, escondidas aún a nuestros antepasados.

Va acompañado el texto por algunas vistas fotográficas, siendo así posible darse cuenta exacta del estado actual de los trabajos referidos en el Uruguay.

Dirigiéndome por este informe a los representantes de la ciencia americana en general, no dejo de dar la terminología de la palabra "fitotecnia," poco conocida hasta ahora en los países de habla española de este continente.

La fitotecnia es una ciencia nueva, análoga (en un campo de acción distinto) a la zootecnia. Se trata en ella de aplicar prácticamente en las plantas todas las leyes modernas de transmisibilidad y herencia, estudiadas y establecidas recientemente en los últimos decenios por biólogos renombrados en todas partes del mundo. No hay necesidad de hablar detenidamente sobre lo que hoy día representa el "Mendelismo" en todas las ciencias relacionadas con la biología. La ley de Mendel, después de ser nuevamente encontrada por varios investigadores a la vez al principio del siglo actual, dió motivo a muy vastas investigaciones sobre herencia y transmisibilidad, de cuyos resultados prácticos mucho debe esperar aún la medicina en su empeño de estudiar la genealogía humana, la zootecnia y la fitotecnia, destinadas las 2 últimas en este sentido a librar la humanidad cada vez más del espanto del Malthusianismo. Nombres como Correns, Davenport, de Vries, Johannsen, Tschermak, Weismann, etc., nos representan los primeros pasos de la ciencia en esta "tierra incógnita." En todo el mundo desde aquella fecha siguen los esfuerzos para llegar a una solución teórica del problema de herencia a fuerza de todos los medios auxiliares de la ciencia moderna de investigación biológica.

Entre tanto la parte de la humanidad, dedicada desde los períodos prehistóricos a la aplicación práctica de tales leyes, sin conocerlas, en la producción ganadero-agrícola, no ha podido esperar hasta que salgan a la luz los últimos auténticos resultados de la ciencia abstracta y así encontramos ya hoy día en casi todos las países civilizados—si no verdaderos institutos zootécnicos—por lo menos la aplicación práctica de la zootecnia, siendo la hermana análoga, la fitotecnia, mucho menos conocida y difundida. No me corresponde aquí hablar más detenidamente de los trabajos efectuados en otras partes del mundo y entre los cuales se destaca por su carácter especial el Instituto Fitotécnico Nacional de Svalöf-Suecia. El Uruguay, al fundar hace 4 años las Estaciones Agronómicas, no dejó de incluir en el programa de tales organismos de investigación agropecuaria los trabajos de investigación sobre un problema de altísima importancia para todo el Río de la Plata, el mejoramiento de la producción agropecuaria por intermedio de la selección científica de plantas, la "fitotecnia."

Por lo general—aunque no sea bien exacto—nos enteramos del estado de la agricultura de un país por el grado de rendimiento, alcanzado en el cultivo del trigo, planta importantísima para la alimentación humana. Tomándolo como base de una comparación general entre algunos países agrícolas, encontramos

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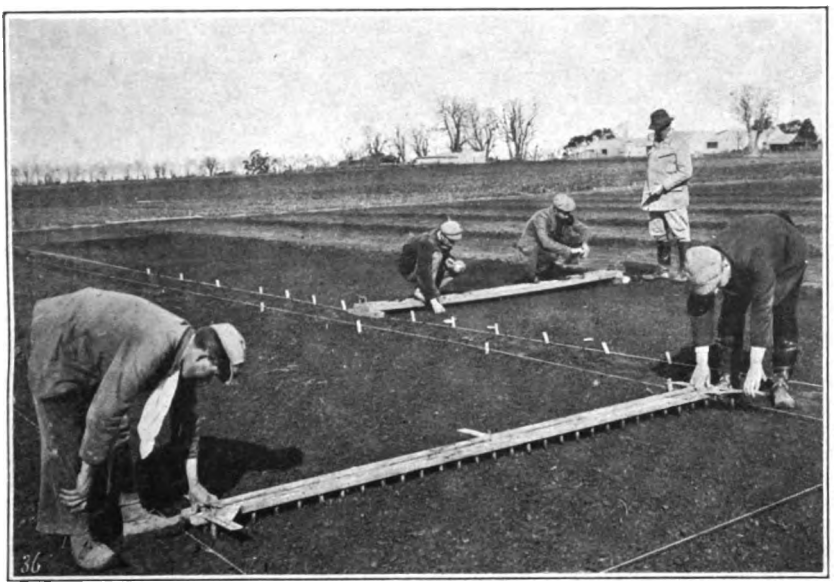
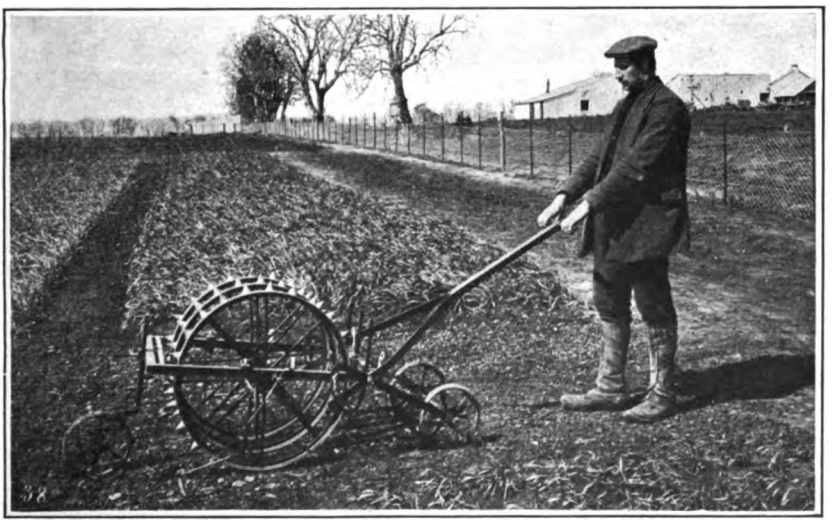


SIEMBRA A MANO DE LOS "PÉDIGREES" EN LOS PLANTELES FITOTÉCNICOS.



MÁQUINA DE AGUJEREAR QUE SIRVE PARA MARCAR LOS SITIOS DE LOS GRANOS DE "SIEMBRAS A MANO."

Se emplea preferentemente para multiplicar rápidamente "Pédigrees" de valor especial.

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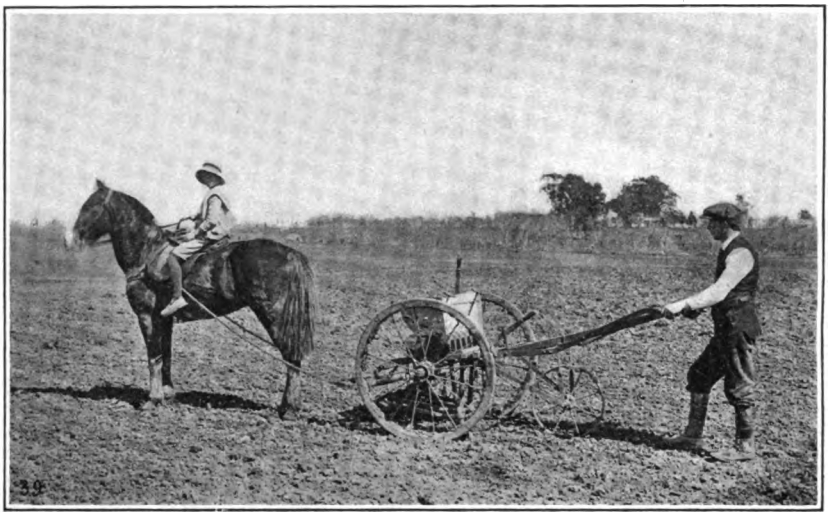

MÁQUINA SEMBRADORA DE 1 METRO DE ANCHO PARA SEMBRAR "ENSAYOS Y MULTIPLICACIONES."

VISTA DE UN ENSAYO SEMBRADO A MÁQUINA.



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en la estadística del año 1913 los siguientes datos de rendimiento medio de trigo por hectárea en quintales métricos (100 kgs.):

| | Quintales. | | Quintales. |
|---|---|---|---|
| Bélgica | 26.0 | Rusia Europea (trigo de invierno solamente) | 9.5 |
| Alemania | 22.6 | Italia | 9.5 |
| Gran Bretaña | 19.6 | Australia | 8.4 |
| Nueva Zelandia | 18.1 | India | 8.0 |
| Egipto | 15.6 | España | 7.8 |
| Austria | 15.0 | Argentina | 7.4 |
| Francia | 13.8 | Rusia Asiática | 6.7 |
| Canadá | 13.7 | Uruguay | 4.5 |
| Rumania | 13.0 | | |
| Estados Unidos | 10.7 | | |

Es cierto que la cosecha de un solo año no debe generalizarse. Pero sin embargo es de dominio público que en el Río de la Plata las cosechas de 800 a 1,000 kilos por hectárea ya representan algo excepcional, en tanto que en países menos favorecidos de Europa se obtienen fácilmente cosechas de 2,000 kilos por hectárea, habiendo regiones en donde el rendimiento llega en el rastrojo de las remolachas azucareras a cuatro mil kilos por hectárea y más aún en años favorables al cultivo.

Surge pues inmediatamente de estos datos estadísticos el problema de la selección de semillas para todo el Río de la Plata. Y especialmente el Uruguay no debe omitir esfuerzos para obtener su posición entre los países de mejor producción, dada la pequeña superficie del país donde no hay regiones extensas desapropiadas para el cultivo del trigo, considerando que las partes, verdaderamente inservibles para la agricultura, ya de antemano quedarán reservadas a la ganadería. El problema es de verdadera urgencia para todo el Río de la Plata donde uno de los principales diarios, "La Nación," en un artículo del día 2 de octubre de 1915 ha tenido motivo de decir:

"Casi todos los países cerealistas se han preocupado desde hace años de la selección científica de cereales y de la creación de variedades locales bien adaptadas al medio que den los mayores rendimientos posibles. La mayoría de nuestros agricultores, no solamente no hacen ni selección y ni siquiera una elemental elección, sino que van muchas veces hasta emplear para semilla lo peor de sus cosechas, lo que no se puede vender." Tales palabras, dadas a la publicidad por un diario de la importancia de "La Nación" en Buenos Aires, significan una crítica bastante seria del estado actual del problema de la selección de semillas en el Río de la Plata.

Y sin embargo, es necesario hablar mucho más y en forma más eficaz aún sobre este tópico por ser "fundamental," puede decirse, para la riqueza de estos territorios nuevos que basan su bienestar en la industria prima de explotación de un suelo riquísimo, sea por agricultura o ganadería.

Bien comprendemos pues que también estadistas, velando por el progreso de los países rioplatenses y representantes del comercio, interesados vivamente en un problema de tanto alcance, han hablado públicamente en varias ocasiones, desgraciadamente sin lograr un pronto cambio de las cosas. Así, por ejemplo, encontramos en el "Aguinaldo de la Sala de Comercio de Productos del País" (1906, p. 56) una crítica del estado lamentable de este asunto en aquel entonces, hablándose de "casos, que hace pocos años se citaban bastante frecuentes, de labradores que vendían lo mejor de sus cosechas, reservándose el refugo para utilizarlo en las siembras siguientes como semilla." Cinco años más tarde, las cosas aparentemente no habían cambiado en nada, dando motivo a que un esta-

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dista llamara la atención sobre el asunto, diciendo el Dr. Don Eduardo Acevedo, en su carácter oficial de Ministro de Industrias (Memoria del Ministerio de Industrias, 1911, pág. 26) lo siguiente: "Nuestra agricultura * * * que no sabe lo que es selección de las semillas como que generalmente reserva para el surco lo que ha rechazado la plaza."

Es cierto que las cosas en el transcurso de los años van cambiando y tendrán que cambiar cada vez más rápidamente el día que tengamos datos concretos de la experimentación e investigación al respecto, efectuadas en el Uruguay por el informante y de los cuales tenemos que hablar aquí ligeramente.

Es actualmente en el Semillero Nacional "La Estanzuela," Departamento de la Colonia, donde se efectúan los trabajos fitotécnicos del Uruguay. Hace un año y medio que el autor de este informe se encuentra al frente de dicho Establecimiento Nacional, siendo la cosecha actual la cuartab otenida por mí en el Uruguay. La primera me la dieron mis planteles fitotécnicos, instalados en muy pequeña escala en el año 1912–13 en el Vivero Nacional de Toledo. El segundo año de trabajo profesional en el Uruguay pasé en la Estación Agronómica de Cerro Largo, ampliando tanto la extensión de los planteles como también el programa general de experimentación.

Aunque por lo general debe considerarse como un serio trastorno en las tranquilas observaciones científicas, un traslado tan repetido de localidad, en este caso la mudanza además de ciertas dificultades ha traído también beneficios para la investigación. Podríamos hablar así también en nuestro caso de la famosa "casualidad benévola" que tan a menudo dió motivo á resultados de gran transcendencia, siempre que el hombre haya sabido sacar las consecuencias de tal "observación casual." La ciencia en general tiene muchísimos ejemplos de progresos notables, obtenidos por hábiles observadores de tales "pequeñeces" del reino de la naturaleza que suelen pasar inadvertidas por la muchedumbre. No me corresponde citar aquí ejemplos al respecto de las ciencias naturales en general, concretándome a llamar la atención sobre el hecho de que también el Instituto Fitotécnico Modelo para todo el mundo, el de Svalöf-Suecia, debe a uno de estos fenómenos su primer paso hacia el desarrollo de hoy día. Una "casualidad benévola" hizo fracasar en el año 1892 completamente el primer ensayo de "fijar" variedades de cereales, trayendo como consecuencia el descubrimiento de la importancia de la "selección individual," hoy día axioma para todos los trabajos fitotécnicos.

Resultados semejantes, ante todo en cuanto a la adaptación de plantas agrícolas a las condiciones de un nuevo ambiente, me dieron los experimentos de Toledo y Cerro Largo, reservándome algunas palabras sobre estos resultados para más adelante cuando en otro párrafo hable de las conclusiones prácticas de este informe. Entre tanto sigamos el desarrollo sucesivo de los trabajos fitotécnicos en el Uruguay.

En el momento de mi llegada al Uruguay en Marzo de 1912, este país carecía absolutamente de datos de experimentación que me pudieran servir de guía para dirigir mis primeros pasos. La tarea inicial era así claramente dada. Se trataba de instalar estudios preparatorios de cuantas "variedades" de cereales rioplatenses era posible conseguir. La representación comercial del mercado cerealista en el Río de la Plata me parecía el lugar más apropiado para satisfacer a mis anhelos y así he obtenido por intermedio de la "Cámara Mercantil de Productos del País" en Montevideo y de la "Bolsa de Cereales" en Buenos Aires algunas variedades rioplatenses de cereales que junto con otras extranjeras conseguidas por intermedio del Ing. Agr. Don José A. Otamendi (hijo) o traídas por mí mismo formaron el primer "plantel fitotécnico" rioplatense. Naturalmente los métodos técnicos de estos experimentos se

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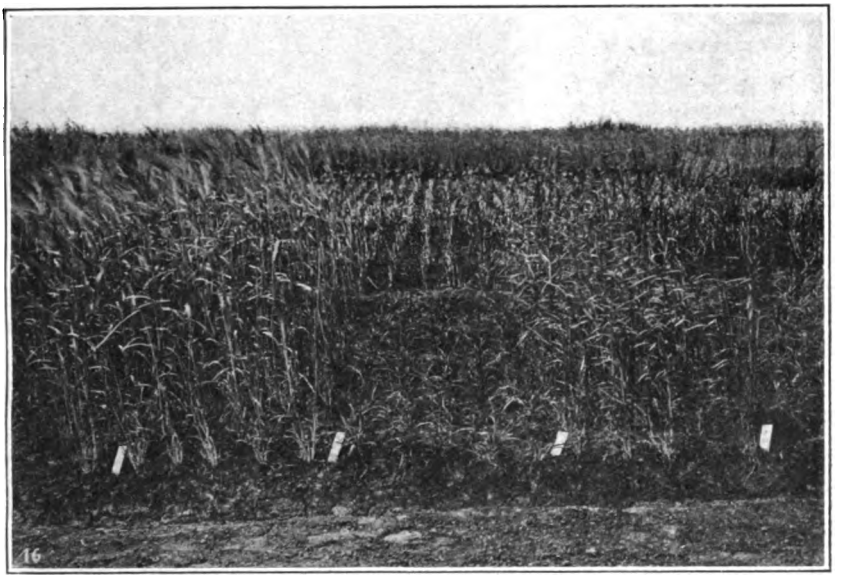
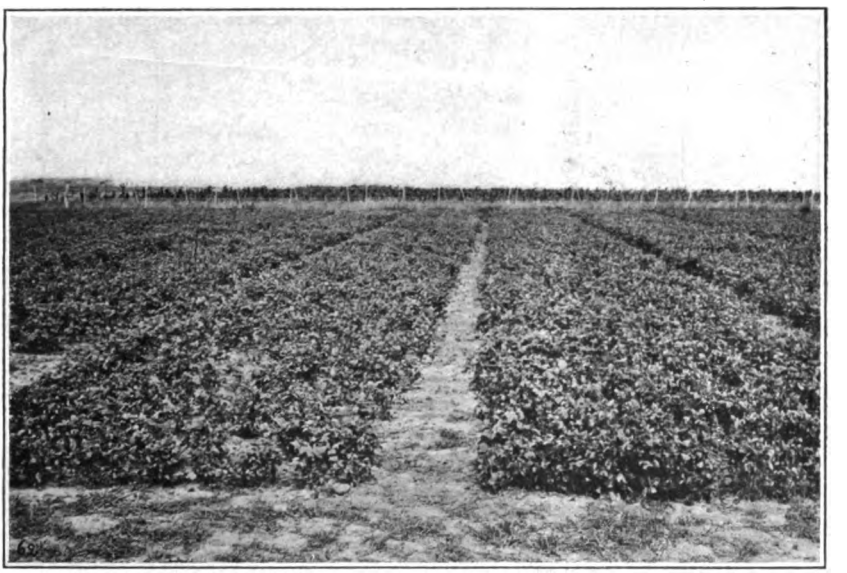


TIPOS DE TRIGO DEL "PLANTEL DE ESTUDIOS PREPARATORIOS" EN EL PERÍODO DE PLENO DESARROLLO.



ENSAYO DE ABONOS ARTIFICIALES CON POROTOS ENANOS DURANTE LA VEGETACIÓN.

A la izquierda sin abono, a la derecha con abono completo.



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ESTUDIOS SOBRE ADAPTACIÓN DE CEREALES. A LA IZQUIERDA AVENA CRIOLLA DE DESARROLLO NORMAL.

A la derecha alrededor de 70 variedades extranjeras atacadas por la Puccinia coronata.

ESTUDIOS SOBRE ADAPTACIÓN DE CEREALES.

Rendimiento de parcelas del mismo tamaño. A la izquierda una de las pocas avenas extranjeras que han podido formar algunos granos, a la derecha avena adaptada (Criolla).



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adaptaron absolutamente al estado más nuevo de la experimentación agrícola europea, siguiendo yo los métodos practicados ya durante varios años por mí en colaboración con el Prof. Dr. Remy en Bonn sobre el Río Rhin, inolvidable y único maestro mío en la especialización referida.

| No. | Procedencia. | Trigo. | Cebada. | Avena. |
|---|---|---|---|---|
| 1 | Uruguay | 24 | 3 | 3 |
| 2 | Argentina | 15 | ..... | ..... |
| 3 | Brasil | 2 | ..... | ..... |
| 4 | Chile | 20 | 14 | 4 |
| 5 | Estados Unidos | 5 | ..... | ..... |
| 6 | Francia | 3 | ..... | ..... |
| 7 | Alemania | 1 | 1 | 1 |
| 8 | Turquía | 1 | ..... | ..... |

El cuadro adjunto demuestra el contenido de los primeros planteles fitotécnicos rioplatenses, tratándose esta vez, como es natural, nada más que un plantel de "estudios preparatorios" siempre dentro de la determinación establecida por mí en estos trabajos.

El segundo año de trabajo profesional en el Uruguay, con la ampliación de mi programa en cuanto al estudio sistemático de variedades extranjeras en los "planteles de estudios preparatorios," ya me permitió entrar en el análisis biológico de la cosecha obtenida en el año anterior, sembrándose por primera vez "líneas genealógicas" para conseguir más adelante "líneas puras" en el sentido de la noción de Johannsen-København (Dinamarca). La experimentación siguió desarollándose en forma bien meditada, subdividiéndose desde luego el total de planteles fitotécnicos en 3 grupos principales, como son:

1°, de estudios preparatorios.

2°, de observaciones.

3°, de cría o de pedigrees.

La totalidad de parcelas sembradas en Cerro Largo era de 1375, número que indica una labor enorme, tomándose en cuenta que los trabajos tenían que realizarse con escasos recursos, pocas instalaciones y menos personal aún. Me es un grato deber, dejar expresa constancia también en esta ocasión, que preferentemente el entusiasmo desinteresado de mi primer colaborador científico, el Ing. Agr. Don Enrique Klein, que desde Noviembre de 1912 siempre ha quedado agregado a mi obra, ha permitido cumplir con éxito completo el vasto programa del año 1913/14.

Debo ser breve en cuanto a los resultados obtenidos en Cerro-Largo. Las "líneas genealógicas," sometidas un examen tan riguroso en forma de un análisis biológico, fracasaron en su casi totalidad. De un total de 408 líneas de cereales (trigo, avena y cebada) no había ni una docena que llenaron completamente las exigencias profesionales; muy pocas pasaron en forma regular y todo el resto, ante todo las líneas evidentemente no adaptadas, desaparecieron por completo, librándome así la misma naturaleza de golpe de tantísimas plantas—"familias," cuyo estudio en condiciones normales quizás habría motivado conclusiones erróneas o por lo menos nos habría dejado llenos de incertidumbre en cuanto al rumbo definitivo de los trabajos que necesitaban efectuarse en los años siguientes. Oportunamente seguiremos con la importancia fundamental de tales resultados.

## II. "La Estanzuela," Medios de Trabajo.—Colaboradores.

El éxito profesional de 2 años de pacientes trabajos en Toledo y Cerro Largo en fin se vió acompañado también por otro, moral, que a su vez ha contribuido

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al mejor desarrollo de mi obra en los últimos 2 años. Me refiero á mi traslado en Marzo de 1914, cuando el entonces Inspector General de Estaciones Agronómicas, Ing. Agr. Don José A. Otamendi (hijo) me encargó la dirección provisoria de "La Estanzuela," función que entre tanto ha tomado carácter definitivo. Debe decirse que "La Estanzuela" se presta bien por la casi totalidad de condiciones naturales para los trabajos científicos iniciados y por instalarse en mayor escala aún, prometiendo tal foco de investigación ya muy pronto verdaderos beneficios para el Uruguay y todo el Río de la Plata. De fácil acceso por todos lados, "La Estanzuela" se encuentra en una zona de agricultores progresistas del Departamento de la Colonia. Los suelos del establecimiento varían algo entre arcillo-humíferos y humífero-arcillosos, representando así un tipo medio de los suelos más característicos del Uruguay.

Un problema sumamente serio para toda la agricultura ríoplatense, la invasión de la langosta, aquí no es tan grave como en las zonas del Norte y Oeste del país, invadidas casi anualmente. Las experiencias demuestran que sólo en años muy desfavorables hay verdadera invasión de langosta.

En cuanto á la ubicación geográfica, debemos contentarnos con pocos datos, a saber: "La Estanzuela" se encuentra más o menos en la línea recta, trazada entre Montevideo y Buenos Aires, las 2 metrópolis ríoplatenses. Queda más cerca de Buenos Aires, capital de la Argentina, hasta donde se llega por ferrocarril (25 km.) y trayecto fluvial (60 km.). La distancia hasta Montevideo es de 225 km. vía ferrocarrilera.

La Estanzuela actual abarca un total de 418 hectáreas, representando el núcleo restante después del remate de la antigua estancia inglesa "La Estanzuela," propiedad de las sucesiones de Jorge y Carlos Drabble, estando formada antes del remate (1907) por una superficie total de 6,426 hectáreas. En cuanto a las construcciones, poco se ha hecho desde aquella fecha, existiendo por eso preferentemente galpones y otros edificios del tipo de uso general en las estancias ríoplatenses. Solamente un laboratorio para los trabajos científicos correspondientes ha sido instalado en uno de los galpones viejos, faltando por consiguiente en el momento casi toda comodidad para poderse depositar, limpiar y clasificar mayores cantidades de semillas, como tendría que ser si ya tuviéramos concluídos todos los trabajos de organización de un instituto fitotécnico completo hasta tal grado que las semillas mejoradas podrían salir en mayores cantidades al país. Existen sin embargo los proyectos de seguir instalando paulatinamente todo lo necesario hasta llegar a tenerse en el Uruguay un completo y verdadero Instituto Fitotécnico, el primero de toda la América del Sur.

Habiéndose expuesto así lo más esencial de "La Estanzuela" actual, en este informe tenemos que dejar todas las otras indicaciones generales, entrando así en la materia misma que nos interesa, los trabajos fitotécnicos y de experimentación agrícola en el Uruguay.

De las 418 hectáreas de "La Estanzuela" han sido destinadas 10 para campo experimental y 3 para planteles fitotécnicos y cuyos planos de sementeras del año actual acompañamos. Se eligió pues el sistema de un terreno permanente tanto para los "planteles fitotécnicos"—criaderos de plantas a mejorarse científicamente—como también para un "campo experimental," propiamente dicho, teniéndose en cuenta en esto todo lo que exige la ciencia moderna de experimentación agrícola al respecto. Sin embargo y a medida que sigamos conociendo bien todas las demás tierras de "La Estanzuela" y que tengamos fondos disponibles para poder ampliar el programa de experimentación, vamos a destinar a esta todo el terreno idóneo del establecimiento. En este año ya entramos en esta fase de desarrollo, habiéndose instalado en la misma chacra

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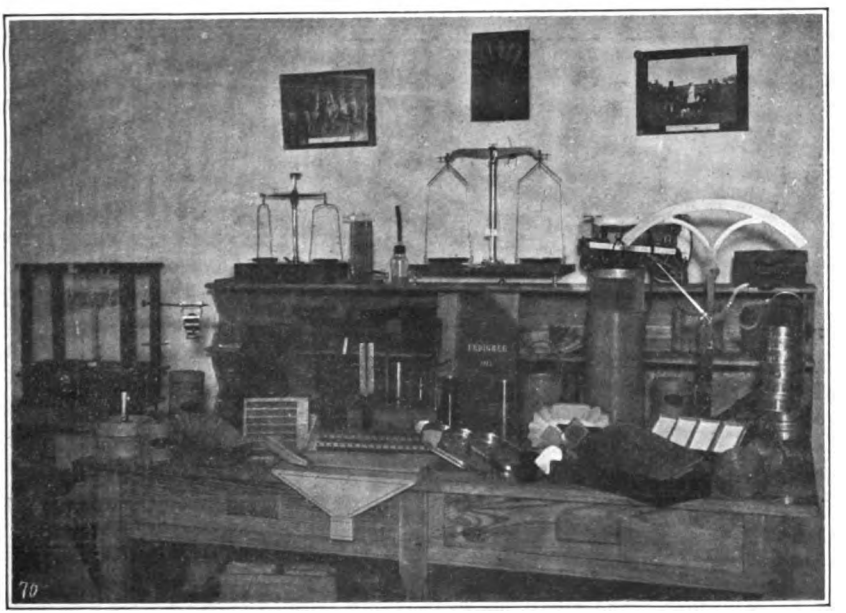
COSECHA DE "PÉDIGREES" EN EL PLANTEL DE CRÍA.



**ÚTILES PARA ESTUDIAR Y ELABORAR LOS PÉDIGREES.**



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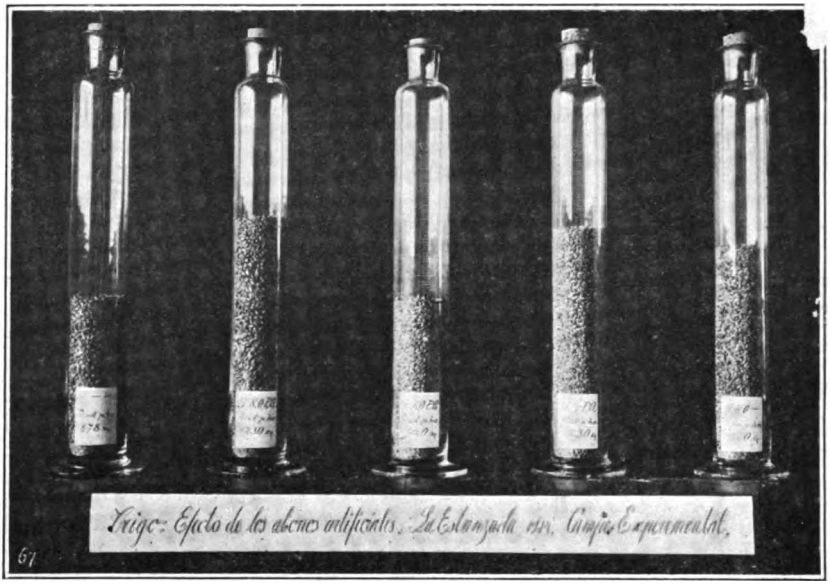
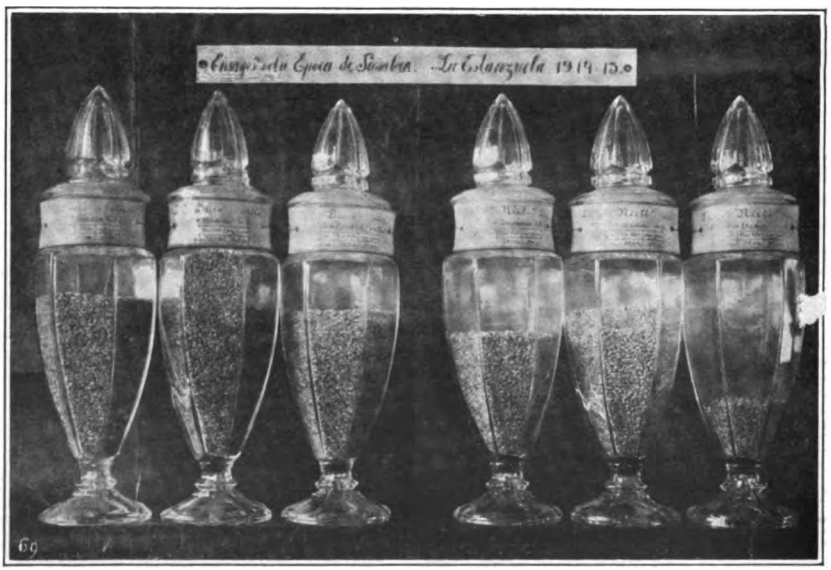



ENSAYO DE ABONOS ARTIFICIALES CON TRIGO, EFECTUADO EN UNA TIERRA ARCILLOSA, POCO HUMÍFERA DEMOSTRANDO BIEN EL EFECTO DE LAS SUSTANCIAS AZOADAS Y FOSFÓRICAS.




EXPERIENCIAS SOBRE ÉPOCA DE SIEMBRA, DEMOSTRANDO QUE LA "MEDIA" HA SIDO LA MEJOR PARA ESTOS 2 TIPOS BIEN DISTINTOS DE TRIGO (DURO Y RIETI).



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un ensayo permanente sobre "rotaciones," adaptadas a las condiciones del país y otro sobre la mejor época de siembra de maíz.

Los demás medios de trabajo siempre siguen siendo escasos en relación con un programa tan amplio como lo tiene ya hoy día nuestro instituto. Por el contacto administrativo con las demás "Estaciones Agronómicas" sigue acentuándose la parte "producción" más de lo que es costumbre en sus similares de otros países. La parte "producción" sin embargo a su vez contribuye en algo a la buena marcha de la parte científica de investigación, facilitando animales de trabajo y haciendo posible un intercambio del personal subalterno, dando así al número del personal, utilizado en los trabajos de experimentación, una cierta elasticidad, cosa que es de suma importancia para la ejecución de todos los trabajos en un momento dado.

Muy recientemente ha sido aprobado por el Poder Ejecutivo un plan de trabajo para "La Estanzuela" por el cual el total de gastos anuales de este establecimiento, alcanzando por el momento $17,397.81 ha sido garantizado por el Ministerio de Industrias. De esta suma $15,420 han sido calculados como entradas propias de "La Estanzuela" para el año en curso.

Más necesario aún para la buena marcha y la organización completa de un instituto científico como "La Estanzuela" es un grupo de colaboradores competentes. Hay por el momento 2 colaboradores científicos:

1°. El Ing. Agr. Don Enrique Klein, encargado de los trabajos fitotécnicos y la experimentación agrícola especial, entró el 20 de Noviembre de 1912.

2°. El Ing. Agr. Don Antonio Götz, encargado de la administración y experimentación en general, siendo por el momento su puesto "provisorio" por encontrarse aquí en comisión especial del Ministerio de Industrias desde enero 1 de 1915.

Además sigue formándose un núcleo de personas competentes en la ejecución práctica de los trabajos especiales y entre los cuales se destaca ante todo el Sr. Don Juán Hamacher, capataz del campo experimental.

### III. Métodos de Experimentación.—Trabajos Efectuados.—Resultados Obtenidos.

En cuanto a los métodos técnicos de la experimentación, usados en "La Estanzuela," sirva de guía la palabra conocida que la ciencia nunca cree en su propia perfección, que se repite el mismo experimento tantas veces hasta que hayan desaparecido todos los errores inherentes a cada obra humana. No es exagerado decir que se hacen 20 experimentos para conocer a fondo un hecho. Esta repetición de las mismas observaciones se hace por partida doble, teniendo en cuenta los factores variables de tiempo y lugar. Considerando el primero se sabe que las condiciones climatéricas de un año son muy distintas a las de otro y que se necesita por eso una serie de observaciones durante un largo período de años para poder lanzar a la publicidad una opinión realmente autorizada. En cuanto al "lugar" ó sitio ambiente de las plantas por estudiarse, cada técnico conoce las dificultades de experimentación originadas por la variación del medio principal de experimentos agrícolas, el suelo, con el agravante que en las tierras nuevas del Uruguay, recién roturadas, tales diferencias se notan mucho más que en las tierras de otros países, explotadas por el agricultor desde hace siglos. Con precaución especial había que elegir pues las parcelas aptas para la experimentación y los resultados, obtenidos en el primer año de trabajo en "La Estanzuela," nos obligaron a eliminar del terreno de experimentación ciertas partes disparejas del mismo "Campo Experimental," destinándolas únicamente a "Multiplicaciones" de semillas seleccionadas sin entrar en un estudio comparativo de las mismas.

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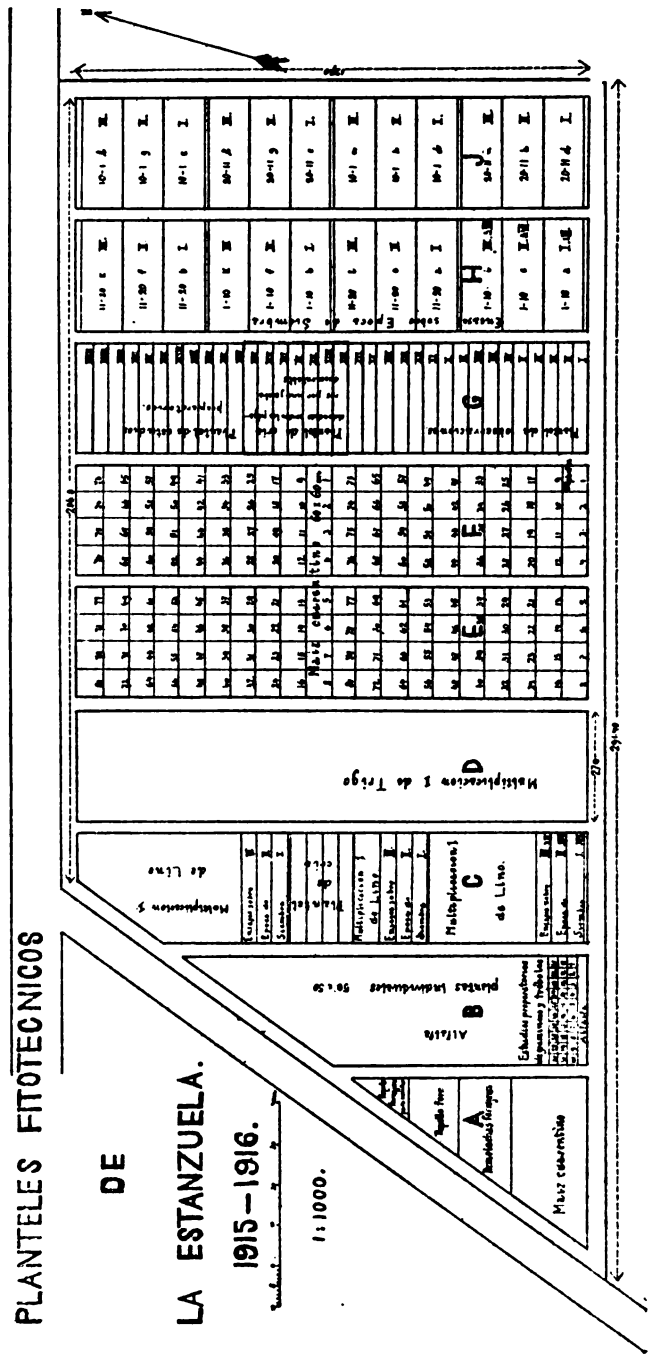


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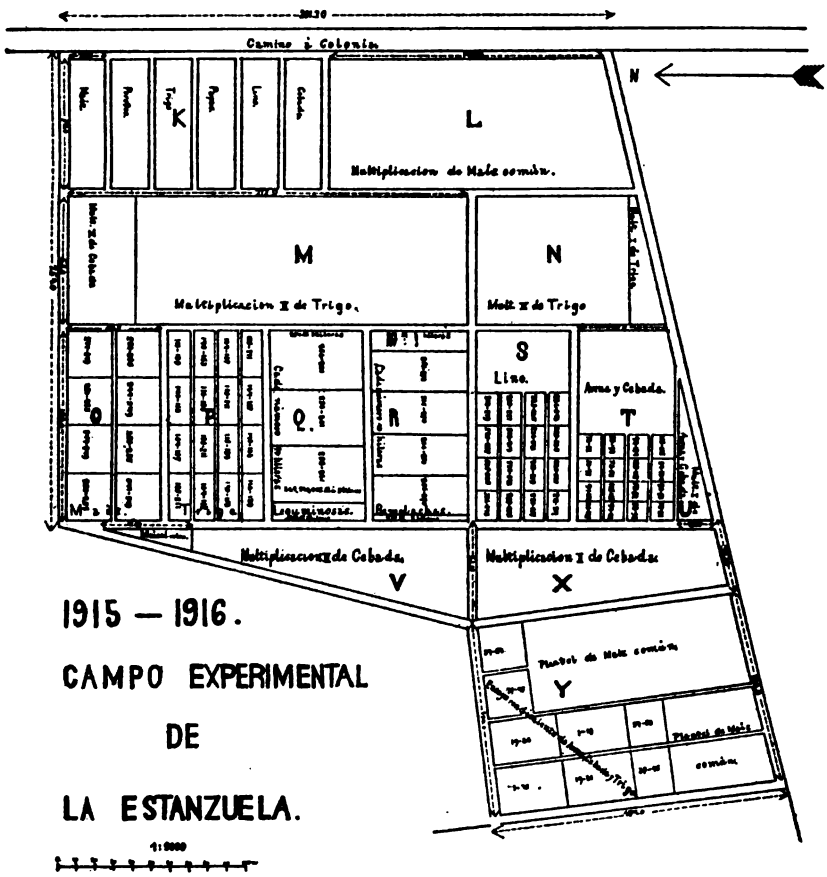
Pero, siempre que tengamos que comparar el rendimiento de un cultivo, variedad, etc., con otro, entran los métodos modernos de la técnica experimental. Se le da a cada cultivo—variedad respectiva—por estudiarse 3 o 4 "parcelas-testigos," sembradas absolutamente en las mismas condiciones, con la diferencia solamente de darles otro lugar en el mismo tablón del ensayo, según un plano bien meditado de distribución de las parcelas. Por lo tanto todas las condiciones son las mismas, menos el factor que debe estudiarse. En fin, se hace desde luego en "La Estanzuela" todo lo que el estado actual de la ciencia




y práctica de la experimentación exige del técnico para poder conceder a sus ensayos un valor comprobativo.

El tamaño de las parcelas del campo experimental varía generalmente entre 10 y 200 metros cuadrados, según las exigencias del caso. El técnico experto en la materia fácilmente puede completar sus ideas al respecto por un estudio de los planos adjuntos tanto del "Campo Experimental" como de los "Planteles Fitotécnicos." El mismo "Plano del Campo Experimental" da una idea también del sistema de rotación proyectado tanto para el tablón "K" y los que llevan las letras O–T, reservándose uno sin embargo siempre la elasticidad necesaria para cualquier "Campo Experimental."

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Por lo tanto, el sistema de experimentación, usado en "La Estanzuela" nos pondrá en condiciones de dar a la publicidad cualquier dato de importancia obtenido por nuestros estudios, con el signo moderno de experimentación científica "±," agregado con algún número al valor principal de un dato, demostrando eso que estamos aplicando los cálculos matemáticos de probabilidad, a fin de indicar exactamente el grado de "oscilación probable" adherente al valor publicado.

Tratándose por el momento preferentemente de estudios fitotécnicos, debe decirse aún que el estudio de las descendencias de una sola planta individual es lo más amplio posible. Ya hablamos de los "planteles de estudios preparatorios" destinados a conocer todas las manifestaciones de vida de un grupo de plantas durante la vegetación. Las variedades que en el plantel de estudios preparatorios por cualquier motivo se destacaron, pasan al "plantel de observaciones" y solamente algunas plantas individuales que resistieron bien a todos los exámenes biológicos anteriores, tendrán entrada al "plantel de cría," donde no hay nada más que verdaderos "pedigrees," base de la selección individual. Ahora bien: De estas mismas descendencias (familias) se sigue eligiendo una sola o algunas plantas excepcionales, siguiéndose siempre el sistema de selección individual, para el "plantel de cría" del año venidero. Los demás descendientes entran en un "estudio comparativo" de líneas genealógicas, sembrándose estas semillas desde luego a máquina en el mismo campo experimental. Y sigue así el estudio hasta llegarse a conclusiones exactas, multiplicándose a la vez las semillas de algunas pocas descendencias excepcionales que luchan por el campeonato definitivo.

Todo eso ha tenido lugar ya en el Uruguay y el año que viene, el 5° de mi trabajo profesional en el Río de la Plata, tendremos por primera vez "semillas de pedigree" en mayores cantidades para poderlas distribuir entre los agricultores del país.

Los demás trabajos de experimentación están a la misma altura técnica, habiendo ya datos concretos sobre la época de siembra de cereales, sobre el problema de los abonos artificiales para el Uruguay y ante todo sobre la adaptación de plantas agrícolas a las condiciones del país. A fin de hacer comprender la amplitud del programa de experimentación—fuera de los "trabajos fitotécnicos" en los "planteles"—establecida en "La Estanzuela" va a continuación una lista de los ensayos instalados en este año, indicándose también la cantidad de parcelas sembradas en total y agregándose a la vez lo más esencial de los resultados obtenidos hasta ahora.

1. Experiencias sobre época de siembra de cereales (trigo, avena y cebada), practicadas con 20 variedades bien típicas del Uruguay y llevando cada variedad en cada época desiembra 4 parcelas—testigo total de parcelas: 240.

2. Experiencias sobre época de siembra de lino, efectuadas con 3 variedades uruguayas con 3 parcelas-testigos, total de parcelas: 27.

3. Ensayo permanente de abonos artificiales con los cultivos de maíz, leguminosas, trigo, tubérculos y raíces, lino, avena o cebada, cada grupo con 4 parcelas testigos total: 120.

4. Ensayo sobre el rendimiento de 70 variedades de cereales (trigo, avena, cebada), llevando cada variedad 4 parcelas testigos; parcelas total: 280.

5. Estudio comparativo de 44 "líneas" y variedades de avena y cebada respectivamente; parcelas: 176.

6. Estudio comparativo de 98 líneas y variedades de trigo, parcelas: 392.

7. Estudio comparativo de los diferentes tipos de maíz, cultivados en su mayoría en el país, parcelas: 48.

8. Estudio comparativo de 31 "líneas" y variedades de lino, parcelas: 124.

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9. Estudio preparatorio sobre adaptación de distintas leguminosas en combinación con un ensayo sobre rendimiento, parcelas: 23.

10. Estudio preparatorio sobre adaptación de algunos tipos conocidos de remolachas forrajeras en combinación con un ensayo sobre el rendimiento, parcelas: 24.

11. Estudio permanente de algunas rotaciones adaptadas a las condiciones del Uruguay, parcelas: 10.

12. Experiencias sobre época de siembra para el maíz, practicadas en la chacra y en 4 parcelas de 3 hectáreas cada una.

Agregando a estas parcelas las de los planteles fitotécnicos, tenemos un total de 2,500 parcelas de experimentación, número que solamente el técnico, un tanto al corriente en la materia, sabrá apreciar en debida forma.

Es natural que en toda la experimentación actual de La Estanzuela reine una preponderancia de la fitotecnia, propiamente dicha, y esto se nota también en todos los demás trabajos agrícolas por entrar en las sementeras en general del establecimiento cada vez más "Multiplicaciones" de plantas de pedigree. Estas "Multiplicaciones" representan los descendientes de las plantas individuales de los planteles fitotécnicos, existiendo en este año alrededor de 70 multiplicaciones de 1er grado; 40 multiplicaciones de 2° grado; 20 multiplicaciones de 3er grado, de cereales.

Sigue pues disminuyéndose el número de las "Multiplicaciones" a la vez que se aumenta el área total sembrada con ellas, eliminándose en el transcurso de varios años todos los tipos que no continúan destacándose en forma esperada. hasta obtenerse muy pocos tipos que saldrán después al país como semilla "mejorada" o "de pedigree" respeectivamente.

Debemos concluir las indicaciones sobre los métodos de experimentación por ser imposible tratar en un pequeño informe general detenidamente todos los problemas científicos relacionados con el desarollo sistemático de la agricultura uruguaya. Repito lo manifestado al principio del informe, que estos datos no son más que una reseña general de lo que actualmente en el Uruguay está llevándose a cabo.

Los resultados obtenidos hasta ahora por los experimentos de los años anteriores no pueden tratarse extensamente en este escrito; pues, para la fiel interpretación de cada experimento se precisaría más bien una publicación especial, conteniendo todos los datos completos, trabajo reservado aún al porvenir. Es así únicamente lo más esencial y lo que puede decirse en forma concreta lo que va a continuación.

1°. Estudios sobre adaptación de cereales y otros cultivos agrícolas a las condiciones del Uruguay. Como es natural, los resultados de tales ensayos no permiten una interpretación general y común para todos los cultivos estudiados. Entre los cereales la avena representa un tipo de una planta sumamente delicada para la adaptación siendo la más rústica la cebada y llevando una línea media el trigo. Casi todas las avenas extranjeras, a no ser del Río de la Plata, no daban resultado satisfactorio quedando la mayor parte sin espigar debido al ataque de la puccinia coronata y las pocas que espigaron dieron granos raquíticos. Entre las variedades estranjeras de trigo había algunas con debilidad biológica semejante a la de la avena, otras se mantuvieron aparentemente bien durante años favorables a su desarrollo, sufriendo sin embargo evidentemente más que los trigos adaptados por cualquier anormalidad de los factores de vegetación. Solamente la cebada se adaptó con más facilidad aunque no haya datos suficientes para poder sostener en todos los casos tal observación. Entre los maíces extranjeros, estudiados hasta ahora, no encontramos variedades de rendimiento mayor que el obtenido por los tipos adaptados del Uruguay. Las



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leguminosas en su casi totalidad durante la vegetación se presentaron bien, quedando sin embargo el rendimiento más bajo de lo que se esperaba.

En su totalidad nuestros experimentos hasta ahora me dieron la impresión que todas las plantas agrícolas tienen que pasar por un período de adaptación, de aclimatación, período tanto más peligroso para las plantas estudiadas cuanto menos se asemejan las nuevas condiciones del cultivo a las de la procedencia. Es cierto que las diferentes variedades y especies reaccionan en forma distinta y puede haber hasta algo de cosmopolitismo en algunos casos. En fin, nos encontramos con problemas que deben ser objeto de vastos y pacientes estudios futuros y en los cuales merece atención especial la conducta de las "líneas puras."

2°. La selección científica de plantas ya adaptadas a las condiciones naturales rioplatenses dió un resultado espléndido, consiguiéndose tipos resistentes a todas las pruebas climatéricas, a veces sumamente severas, en cuanto a los cambios bruscos de la temperatura en la primavera, circunstancia que debe ser objeto de estudios especiales en el porvenir. He llegado a tal opinión debido a los resultados contradictorios en los distintos años obtenidos por los diferentes tipos de trigo seleccionado individualmente. Los tipos más aventajados del año 1912/13 fracasaron al año siguiente, saliendo triunfantes tipos de "menor vista," modestos, sí, pero de más vigor y elevada fuerza intrínseca, bien guapos y rústicos para poder resistir a los fríos nocivos durante el período de la floración y formación del grano. Son estos los tipos que representan la base del trigo uruguayo del porvenir que dará cosechas normales también en años de condiciones desfavorables. En el último año, poco propicio al desarrollo del trigo, como es sabido, descendientes de este tipo dieron una cosecha de 2,000 kilos, dato que hace esperar mucho, si se le compara con las cosechas mezquinas rioplatenses, de las cuales hablamos al principio, siendo 800 a 1,000 kilos por hectárea ya "cosecha buena."

3°. Experiencias sobre la época de siembra de cereales.

Hay resultados concretos de 2 años seguidos que no permiten aún conclusiones bien claras al respecto. En el año 1913/14 resultó mejor la siembra "tardía" y en el año 1914/15 la "media," oscilando las épocas—siempre según las circunstancias del tiempo, etc.—de mes a mes más o menos. El problema, sin embargo, reviste seria importancia para el Río de la Plata donde hasta hoy no existe una experimentación amplia al respecto.

4°. Los ensayos con abonos artificiales en distintos cultivos probaron nuevamente que la substancia nutritiva que hace falta a casi todos los suelos uruguayos, el ácido fosfórico, también para "La Estanzuela" representa el factor de vegetación que se halla en la cantidad menor en relación con la ley fundamental agrícola, la del "mínimum" o conocida también como la de Liebig. En algunas tierras del Establecimiento Nacional "La Estanzuela," aparentemente faltan también otras materias nutritivas para las plantas, notándose, por ejemplo, el caso que por el empleo del Salitre de Chile como abono azoado de cobertura se pudo aumentar el rendimiento de los cultivos en un 30%.

Las explicaciones anteriores, aunque no hayan sido extensas como debían ser para tratar nuestro problema desde todos los puntos de vista, nos han dado sin embargo una idea general de trabajos de experimentación agrícola y estudios fitotécnicos que representan un "nuevo paso"—hablando así—para la agricultura de todo el Río de la Plata. Se nota cada vez más que existe la posibilidad de mejorar considerablemente las cosechas de estos países, escasas y mezquinas realmente si se tienen en cuenta las condiciones naturales para la producción agrícola, sumamente favorables en su casi totalidad. Trabajos fitotécnicos, dedicados a un estudio sistemático de la *adaptación* de plantas

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agrícolas extranjeras y a un *mejoramiento* sucesivo de los tipos criollos ya adaptados, en combinación con un estudio esmerado de otros problemas actuales de la agricultura nacional, tendrán que dar el primer impulso para los progresos futuros. Son pues tareas del investigador, bien concretas y limitadas que abrirán el primer paso al progreso, quedando a la enseñanza el deber de instruir al agricultor en general para que vaya aplicando cada vez más los descubrimientos de métodos, buscados a propósito para cada zona distinta. Esto es lo que toca decir en un sentido especial acerca de los trabajos iniciados en el Uruguay.

Ahora un momento después de esta recorrida rapidísima detengámonos por un extenso campo científico, demarcado en este informe, a fin de contemplar de hito en hito a la misma "Ciencia," aparentemente muy seria y sin embargo burlándose de la audacia humana, empeñada en arrancarle secreto por secreto. Se nos presentan ideas y tareas más vastas, comunes para todos los países donde desde ya se efectúan trabajos científicos de la índole demostrada en este escrito. Teniendo en cuenta que según el Programa Preliminar del Segundo Congreso Científico Panamericano la Sección III tendrá que discutir: "los métodos para la conservación del cultivo de las plantas por el uso de sistemas perfeccionados de producción, por el empleo de plantas naturales del país que ahora no se cultivan, etc.," me viene el pensamiento que a este mismo Congreso Científico le deberían tocar los pasos preparatorios para una organización sistemática de todos los trabajos relacionados con este tema. Cada país—es cierto—tendrá sus problemas fitotécnicos especiales, para llegar al fin buscado o sea:

Conseguir y asegurar el máximum de rendimiento de la energía solar por intermedio de la máquina—planta, puesta en marcha, manejada y dirigida por el obrero agricultor.

Pero hay problemas urgentes de importancia general y eso es lo que debe tratarse de resolver por esfuerzos comunes. Sería así de verdadera importancia organizar un servicio internacional entre los países interesados, á fin de estudiar a fondo el problema de adaptación de plantas agrícolas procedentes de distintas condiciones naturales. Cada país tendría que tener un organismo técnico, encargado de las tareas que en Norte América corresponden al: "Bureau of Plant Industry" repartición del "United States Department of Agriculture, Washington, D. C." Convendría buscar a la vez una fórmula concreta para poder instalar un intercambio permanente, tanto de los "medios de investigación," en nuestro caso semillas de las plantas agrícolas de interés general, como también de los "resultados de la investigación" en cada momento dado.

Es necesario proceder en tal forma a fin de poderse estudiar a fondo el problema de la adaptación de semillas, procedentes de otros países en combinación con ciertos problemas biológicos de la investigación sobre transmisibilidad, etc. Las "líneas puras," los "pedigrees" probablemente tendrán una importancia especial en este sentido, permitiendo efectuar trabajos científicos, destinados a reducir tantísimas hipótesis y teorías a una o algunas fórmulas concretas de "ley," que rigen en un campo científico muy poco explorado aún.

Darwinismo y Mendelismo, así se llaman los primeros jalones que marcan la entrada a este terreno de la ciencia, no sabiéndose todavía, como poner otros jalones de orientación general y menos aún en qué forma practicar la demarcación definitiva en esta parte de la ciencia.

The CHAIRMAN. The subject of the next paper is "The progress of agricultural science in Cuba," by Director J. T. Crawley, of the Cuban Agricultural Experiment Station

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# PROGRESS OF AGRICULTURAL SCIENCE IN CUBA.

By J. T. CRAWLEY,

*Director of the Cuban Agricultural Experiment Station.*

It is the purpose of this paper to present briefly the progress which has been made in recent years in applying the principles of science to agricultural processes in Cuba. The predominant interest of most of the nations represented in this Congress is agriculture, and as the nations become better acquainted with one another, more minute study will be made of one another's methods by which progress is brought about. As the predominant interest of the nations as a whole is agriculture, it is natural to suppose that the improvement of agriculture and agricultural methods will, in the near future, be given a large amount of attention by the several Governments. In all countries where agriculture has become a science, and where new methods, new processes, new implements have enhanced the production of the soil and lightened the burden of the farmer, the agricultural experiment station has been in the forefront of the line of progress. It is natural to suppose that as the interest of the Government is aroused, attention will be paid to agricultural education and to agricultural investigations. The writer will therefore give an account of the establishment of the agricultural experiment station of Cuba and a résumé of the principal problems with which it has busied itself, together with the success or failure of its attempts, trusting that our experience may be useful to those who have yet to take up seriously the question connected with the science of agriculture.

The Cuban Experiment Station was established in 1904 by Estrada Palma, the first President of the Republic of Cuba, two years after his inauguration. The objects of the station were set forth by its first director, Prof. F. S. Earle, in the first official publication of the station as follows:[1]

An experiment station is primarily an institution for investigation. Its constant aim is to discover new facts and principles that will be of practical use to agriculture. It studies the local conditions affecting each crop in order to be able to suggest improved methods of management that will make the crop more profitable. It studies varieties of plants and breeds of domestic animals in order to determine which ones are the best fitted for different localities and uses. It attempts the improvement of existing varieties and the origination of new ones that will be better suited for special purposes. It seeks to introduce new crops and useful plants in order to secure the benefits of diversified industries. It studies the requirements of different markets and the best methods of transportation in order that the highest possible prices may be realized for all crops. It specially studies the different types of soils to determine their chemical and mechanical composition, their geological history, the character of their native vegetation, and any other facts that will help to determine their adaptability to different crops and the best means of retaining and increasing their productiveness. It studies the insect enemies and diseases of economic plants and domestic animals for the purpose of finding means by which losses from these causes can be avoided. In short, an efficient experiment station should be prepared to investigate any scientific or practical question that concerns the prosperity of agriculture. This is a high ideal. In practice it can seldom be fully realized owing to lack of means and to the limited abilities of investigators.

While the first business of an experiment station is thus the gaining of knowledge, the dissemination of this knowledge among the classes it is calculated to benefit is equally important. For this purpose the station will issue a series of circulars, bulletins, and reports for distribution in which the results of its investigations and studies will be recorded. Its officers will visit different parts of the island for the purpose of meeting the people and learning the

[1] Circular No. 1. Propositos de la Estacion Agronomica.

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special needs of the different sections. It also offers its services freely in answering inquiries by letter in regard to agricultural questions of all kinds. The officers of the station do not wish to be understood as assuming to possess full knowledge of all agricultural questions. On the contrary, no one realizes its shortcomings in this respect more fully than the conscientious investigator.

The station is, however, equipped for the special purpose of finding out facts. We are acquiring a library and laboratories, and we are in communication with other similar institutions in the other parts of the world. We therefore cordially invite correspondence in regard to any matter of agricultural interest, and if we do not have the required information at hand we will use our best efforts to obtain it.

Although there have been many changes in the personnel of the station and interruption of its work, due to various causes, nevertheless the original program has to a large extent been followed.

The station is divided into departments, each with its chief, assistants, and necessary laboratory and other facilities, as follows:

1. *Agriculture.*—To this department is given the experimental work with the more important crops, such as sugar cane, tobacco, corn, and the various crops used for cattle feed and green manuring.

2. *Horticulture.*—This has charge of the growing of fruits and vegetables and the care of the grounds.

3. *Botany.*—This department has gathered and cares for a herbarium of Cuban plants and has charge of the study of forest trees, their distribution and utilization, vegetable fibers, medicinal plants, etc.

4. *Chemistry.*—Analyses of soils, fertilizer, and agricultural products, not only those originating in the station but those sent from without. This department also has certain well-defined fertility problems for investigation.

5. *Pathology and entomology.*—This is one of the most important departments, since it has the difficult problems of the study of the insect and plant diseases and proper methods for eradicating them. The problem has been more difficult, owing to the fact that the Tropics offer ideal conditions for the development of plant enemies, both insects and diseases, and since so little work of this kind has been done in the Tropics.

6. *Animal diseases.*—The laboratory carrying on investigations in animal diseases and engaged in preparing vaccines and serums was established under the direct supervision of the office of the secretary of agriculture and was transferred to this station in March, 1914. While it has the study of animal diseases in general, its principal work at the present time is the preparation of vaccines used in combating anthrax and blackleg and of hog-cholera serum.

7. *Veterinary medicine and animal husbandry.*—This department is charged with the introduction and breeding of the best breeds of domestic animals, the study of butter and cheese making, the feeding values of various Cuban-grown feeds, and also the study of animal diseases.

While each department has its own apparatus and problems, yet there is no fine line of demarcation between them, and the closest cooperation among all officers is fostered.

The sugar industry is by far the most prominent of all Cuban industries. In 1904 the total exportation was 1,229,583 short tons of sugar, while in 1915 it was 2,836,378 short tons, or an increase during this period of more than 130 per cent. It would be supposed that the greatest advance in methods of cultivation would be connected with this crop, but such is not the case. The increased production of sugar is not the result of better varieties of cane, or better methods of cultivation, except in a very limited sense, but to the extension of the cultivation to the virgin lands of the eastern part of the island and to better factories and factory processes. Great improvement in machinery

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and factory processes have been made during this period, and it might be said that the Cuban mills are among the best in the world. But sugar-cane agriculture has made few advances, and it can truthfully be said that it is in a more backward condition than in most cane-sugar countries.

A great many foreign varieties of cane have been introduced and are growing at the experiment station, some of which give promise of being of economic importance in Cuba; but as yet the cristalina is the main dependence of the Cuban planters.

The growing of seedling canes, which has been of such great benefit to those countries where the work has been consistently pursued, particularly in the British West Indies and Java, has received but little attention in Cuba. Mr. Edward F. Atkins, owner of Central Soledad, has for 10 or 12 years maintained a private experimental field, particularly for the purpose of growing seedlings for his own estate, but the results of the work are not made public.

It has been abundantly proved, first by well-conducted experiments at this station and then by the plantations themselves, that wide planting of sugar cane does not give good results on the old lands; and thus a tendency toward planting the cane at greater distances, which was seen at the time of the establishment of the experiment station, has been corrected. Experiments, as a rule, have shown that fertilizers do not give good results on the black land, but do result on the red, and particularly the older of the red lands. The use of fertilizers therefore is increasing in the western part of the island, while the relative value of phosphoric acid and potash in the fertilization of sugar cane on these soils has not been definitely determined, the great value of nitrogen has been clearly established. It is the chief element in the fertilization of sugar cane.

The greatest advance to be looked for in the cultivation of sugar cane, outside of the adoption of better varieties of canes, is in the preparation of the soil. As a rule, the sugar estates are comparatively level and well adapted to the use of all sorts of agricultural implements, but, strange to say, the use of power plows had gained no headway until a few years ago. The plowing has been very superficial, merely a scratching of the surface. The Cuban soils are ideal for deep plowing. The red soils are very deep, and the black soils would be greatly benefited by deep plowing, inasmuch as it would bring up more lime to the surface and greatly improve the drainage. During the past few years special efforts have been made to adapt the American tractor plows to the Cuban fields, and in some cases with admirable success. This is the greatest advance in Cuban agriculture for a great many years and bids fair to revolutionize methods of cane culture.

The Fowler steam plow, using a cable to pull a gang of moldboard plows, was tried a number of years ago, but its use was abandoned. This was probably more for a lack of understanding than for any defect of the outfit itself, since it has been successfully used in most other sugar cane growing countries. Lately a number of outfits have been purchased and are giving very satisfactory results. It is the only one that thus far has given complete success in heavy black lands. The American tractors use both the moldboard and the disks, but the latter are preferable where the soil is not too hard for them to enter properly.

The amount of calcium oxide in Cuban soils is unusually high. The average of a number of analyses of sugar-cane soils gives 3.4 per cent of this substance, which is higher than in most other countries.[1] To the practice of leaving cane trash unburned on the field and the high lime content of the soils is

[1] From an unpublished manuscript of the author.

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due, in a large measure, the fact that Cuban soils can be cropped many years without either fertilizing or replanting, and to this, in turn, is due the high position which Cuba holds as a sugar producing country.

Until recent years when cane was cut the trash was allowed to remain where it fell, and the only care that was taken of the fields subsequently was to remove the trash from around the stools to allow the germination of the cane, and the destroying of weeds and grass wherever they appeared. In virgin land, where vegetation was vigorous and the land after harvest was covered with a thick mantle of cane leaves, there were very little weeds and grasses. Grass and weed seeds had not yet found their way in large quantity into the new land, and the thick mantle of leaves prevented their germination. But as the lands became old, as seeds were introduced, and the mantle of leaves became thinner and thinner, owing to a decreased yield of cane, the cost of weeding often became prohibitory. In recent years it has become the practice on a great many plantations to put the leaves in every other row and cultivate the row thus left bare. This is an ideal practice, inasmuch as moving the trash is very cheap, the thick covering of leaves prevents the growth of weeds and grasses, and the cultivation of every second row keeps them clean and tends to preserve the moisture. One of the greatest benefits of the cane trash is the protection of the soil from the drying effects of the sun. The author has tested this question repeatedly and has always found a larger percentage of water in soil thus protected than in soil not so protected. For instance, during a period of nine months soil protected with cane trash contained an average of 4.1 per cent more water than a corresponding plant left fallow.[1] A difference of 4.41 per cent between similar plots has been noticed in Cuba. This is a very notable difference, and shows strikingly one of the reasons for protecting the soil with cane trash.

It has been the policy of the Cuban Government, just as it has been the custom of governments of most other countries, to foster and encourage the smaller industries, leaving the larger ones to take care of themselves. The importance of the sugar industry in Cuba is sufficient to justify the establishment and support of an experiment station especially devoted to sugar cane, as has been done with such signal success in Hawaii and Java by the sugar planters of those islands, and that will likely be done in Cuba.

Just as nitrogen has been proved to be the chief element in fertilizers for the production of cane so phosphoric acid has proved the dominant element in the growth of tobacco.[2] But whereas it is known that nitrogen has no deleterious effect on the quality of sugar, and therefore can be used without fear of doing any damage, the effect of phosphoric acid on the burning and other qualities of tobacco has not been carefully determined. The predominant effect of stable manure on the production and quality of the leaf, and of potash on the burning qualities of the elaborated tobacco, are so well known that the fertilizer requirements of the tobacco plant are now fairly well determined.

Experiments now being carried on look to the determination of the effect of shade, of fertilizer, and of different quantities of water on the composition of the leaf.

During the years 1907 to 1909 Dr. H. Hasselbring, who was chief of the department of botany of the station, undertook a study of the composition of the tobacco plant in Cuba, to determine if there was a true Cuban type.[3]

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[1] Bulletin No. 8 of the experiment station of the Porto Rico Board of Agriculture.

[2] See Bulletin No. 16 of the Cuban Experiment Station.

[3] Botanical Gazette, Vol. LIII, No. 2, Feb., 1912. Also Bulletin No. 23, Estacion Experimental Agronomica de Cuba.

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He called attention to the fact that the tobacco fields in general lack that uniformity which is characterstic of any field of plants of one variety in regions of more advanced agriculture—in other words, that the tobacco grown did not belong to one special type but to many. This would also be suspected from a consideration of the great number of grades into which the manufacturer is obliged to separate the tobacco even from one farm. It was shown that from the indiscriminate method of gathering seed, and the purchase of tobacco plants without regard to the characteristics of the plants bought, any foreign strain of tobacco seed once introduced into Cuba would probably never be eliminated. He showed that the plants descended from any type are true to that type. This fact, together with the fact that each plant bears such a large number of seeds, makes the selection and propagation of a pure type of tobacco very simple.

It has been shown that many introductions of foreign seeds have been made, particularly after the wars when the industry was almost destroyed. The station has recently taken up the work of selection, and within a very few years the whole island can be supplied with a uniform type, and it is natural to suppose that the quality of the tobacco will be enhanced as the pure havanensis type is secured.

During the past 10 years a considerable part of the leaf used for wrapper has been grown under cheese cloth both in the Vuelta Abajo and in the Partido sections of Cuba, and the same author studied the effect of cheese cloth on transpiration and assimilation in the tobacco plant. It was found[6] that the transpiration of tobacco plants grown in the open is about 30 per cent greater than the transpiration of plants grown under the cheese-cloth shade commonly used for shading tobacco in western Cuba. The transpiration per unit area of leaf surface is nearly double in the sun plants as compared with those grown in shade. The total plant substance in the shade and in the sun were very nearly equal, but there was a much larger area of leaf surface in the plants grown in the shade. There is, therefore, practically the same weight of tobacco per given area in the shade as in the sun, but in the former case less water is required and a finer and larger leaf is secured.

Considerable improvement has been made in the past 10 years in the growing of vegetables, both for home consumption and for foreign markets. It has been determined that almost all of the vegetables that are grown to any considerable extent in the United States can be successfully grown in Cuba during the winter months. A complete study has been made of the conditions under which they can be grown, so that the problem of vegetable growing has been pretty well worked out. The greatest drawback is the fact that the growing season for vegetables corresponds with the dry season of the year, and therefore only those who are supplied with an irrigation plant can grow them successfully. The exportation of vegetables is given in the following table, from which it will be seen that this crop has become one of importance:

| | Value. | | Value. |
|---|---|---|---|
| 1902 | $78,229 | 1909 | $184,837 |
| 1903 | 64,663 | 1910 | 136,938 |
| 1904 | 164,673 | 1911 | 186,337 |
| 1905 | 173,795 | 1912 | 178,801 |
| 1906 | 93,761 | 1913 | 169,306 |
| 1907 | 174,677 | 1914 | 231,585 |
| 1908 | 283,604 | | |

[6] The effect of shading on the transpiration and assimilation of the tobacco plant in Cuba, the Botanical Gazette, Vol. LVII, No. 4, April, 1914, and Bulletin No. 24 of the Estacion Experimental Agronomica de Cuba.

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Of all fruits which have been tried on commercial scale practically the only ones that have given remunerative results are the citrus fruits, and of these oranges and grape fruits have given the best results. Budded trees are grown at the nureseries or imported from the United States. For the best results trees have to be fertilized heavily, and potash is probably the most important element in trying to obtain a marketable fruit. The experiment station has found a few varieties of peaches and Japanese persimmons that seem suited to the local conditions, and the planting of these varieties in the country is being extended. While both insects and plant diseases have to be looked after considerably, there is nothing encountered yet that can not be overcome by the intelligent grower.

The animal industry is one of the largest in Cuba, its value being only less than that of sugar cane and tobacco. The cattle are hardy but of a nondescript breed, having been brought from Venezuela, Mexico, and the United States. The cows do not produce much milk and what is produced is not rich, and the oxen are not as good at their work as could be desired. Continuous efforts at improving the breeds have been made for the past 15 years. Jersey cows do well when they are well taken care of, but they will not thrive under the treatment that the Cuban farmer is accustomed to give his cattle. The Holstein is one of the best breeds that have been introduced, both for milk and beef, while the Durhams and the Aberdeen Angus are giving good results in the regions devoted to cattle raising and where there is a sufficiency of feed. The Indian, or Mysore, breed of cattle has in recent years been introduced and promises to be the most valuable introduction in recent years. The pure-breed cattle are rather nervous, but the mixed breed of this and the native Holstein or Aberdeen Angus cattle promise to give work cattle with the strength, endurance, and rapidity of movement of the Indian and the docility of the other breeds. The station has mixtures of the Indian with both native and introduced cattle, and on the whole they appear to be the most promising cattle for general farm purposes with which we have experimented. They are large, strong, they walk fast, and their short hair is of advantage where there are so many ticks as in the Cuban pastures. They and their offspring are very resistant to the Texas fever, which is so often fatal to cattle imported from noninfested territory.

### FEEDING OF DOMESTIC ANIMALS.

The feeding of farm animals during the growing season, or from June to December, does not present many difficulties, as during that time rains are plentiful and almost all kinds of cattle feed can be grown without difficulty. Corn, sorghums, leguminosae, and pasture grasses grow luxuriantly. Unfortunately, however, they can not easily be preserved, because the grains are destroyed by multitudes of insects, and because there is not a good season for hay making, and the grasses grown in Cuba do not lend themselves so readily to hay making, as do those grown in the north. The consequence is that during the dry months, say from January to May, there is a scarcity of cattle feed and much is imported from the United States, as will be seen by the following table showing the value of the importation of the principal foodstuffs during the past two years:

| | 1912-13 | 1913-14 |
|---|---|---|
| Hay and bran | $486,027 | $461,846 |
| Corn | 2,347,257 | 2,445,585 |
| Barley | 402,440 | 372,164 |
| Oats | 699,432 | 683,894 |
| Total | 3,935,136 | 3,963,489 |

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In the north the silo is used for preserving ensilage that is grown during the warm months for consumption during the winter months. A number of trials have been made looking to the adapting of the silo in Cuba for preserving ensilage for consumption during the dry months, and with complete success, and this success should interest all tropical countries that suffer from the effects of dry season, or in which for any reason there is a scarcity of feeding stuffs at any particular periods. Corn is the best material for preserving, and fortunately this grows well and produces abundantly. Corn ensilage can be grown, cut, and placed in the silo at a total cost of $3 per ton, even in the comparatively poor lands of Habana Province. The ensilage is grown from May to October and fed from January to May. The silo is being adopted to some extent, and its general adoption would cut down quite materially Cuba's bill for foreign feeds, as shown in the above table.

Cuba is an ideal country for the raising of hogs. The royal palm trees, of which there are millions in the island, furnishes a food which is very much liked by the hogs and which is very nutritious. Guavas, mangoes, and other fruits grow in profusion and serve very well as feed. Moreover, the market for pork and all of its products is always very good. Unfortunately hog cholera is always epidemic and causes such a high death rate among the hogs as to make the business of hog raising exceedingly precarious. No extensive statistics are at hand to show either the total number of hogs in Cuba or the number that die annually of cholera, but in many cases herds have been completely destroyed by this disease. There is no remedy known, but hog-cholera serum is a preventive, and the experiment station began preparing the serum about a year ago and to date has prepared about 500,000 cubic centimeters and used it with the greatest success. We have met with a number of difficulties in the preparation of the serum which has prevented the working of the plant to full capacity, but at present we can see no reason why the difficulties should not be overcome as they have been overcome in the United States. The importations of lard, hams, and live hogs during the year 1912–13 amounted to $8,983,884, and during the year 1913–14 to $9,357,721. From these figures it will be seen what the placing of the industry in the condition to supply all the local consumption would mean to the Cuban farmers.

Very little intelligent attention has been given in Cuba to the raising of chickens. Every farm has a few chickens, but they are allowed to a large extent to care for themselves, and as a consequence eggs and chickens are both scarce and expensive. During the year 1913 there were imported into Cuba eggs of a value of $1,218,905, and during the year 1914 this amounted to $1,236,199. A few serious attempts have been made to establish chicken ranches, to supply the local market with eggs and poultry, but, either from a lack of understanding of the business or from encountering unexpected difficulties, the ventures as a whole have not been successful. The experiment station has tried out the best of the northern breeds of chickens, and we find a few, like the Rhode Island Red and White Leghorn, to be perfectly adapted to this country. The diseases that one encounters are not those that are most common in the north; the climate is much warmer, the feed different, and the poultry raiser will have to adapt himself to the changed circumstances; but we see no reason, after several years' study, why enough chickens should not be raised, and at a profit, to supply the market.

Blackleg and anthrax are other diseases very common and very destructive. During the nine years commencing in 1906 and ending in 1914 there were

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distributed by the station 3,169,455 doses of blackleg vaccine and 546,728 doses of anthrax vaccine.[1]

Requests were made to those to whom the vaccines were distributed to send a report of their efficacy. Owners of 845,102 cattle reported that before using the vaccines 27,156 of their cattle, or 3.2 per cent had died of the diseases, and after treatment 6,568, or 0.8 per cent. It will thus be seen that the vaccines have been very effective, and the petitions for them are increasing greatly from year to year.

The problems already mentioned are a few only of the many in which the experiment station has been engaged in studying, but they are but a few, since an institution of this kind in a country like Cuba where little attention has been paid to the scientific principles of agriculture, has an almost unlimited field in which to extend its investigations.

The chief function of an experiment station is to investigate agricultural problems and discover underlying facts and principles, but the knowledge thus obtained would be of little service unless it can be diffused among the farmers for whose benefit the station is supported. It becomes, therefore, necessary to establish a medium of communication between the station and the people. This is done by the publication of reports, by answering consultations by letter and in person, and by maintaining demonstration plats where principles are exemplified in the presence of the people. One of the great difficulties in carrying on the work in Cuba has been that there has been devised no efficient method of reaching the farmer, who, as a rule, is indifferent to suggestion looking to the improvement of his processes. This, however, has been encountered in other countries as well as in Cuba. The Department of Agriculture is attempting to solve this by the creation of a section of the department called "Vulgarizacion Agricola." At the head of this service is the general inspector of agriculture who has under his direction several agricultural engineers. This section publishes pamphlets on timely topics and holds meetings of farmers for the purpose of discussing farm methods. Besides this, it establishes demonstration plats in various sections of the country and illustrates in a practical manner the best methods of planting and cultivating crops. This service needs to be greatly extended, for it will relieve the experiment station of this work and will permit it to spend more time in its more obvious functions of carrying on investigations.

One of the greatest drawbacks to the work in Cuba has been the difficulty of finding Cubans with the necessary education and qualifications for carrying on investigations. This is not strange when it is remembered that this work is new in Cuba, and the educational system has not been readjusted to meet the situation. It is difficult to secure foreigners, and they are never efficient at first owing to their ignorance of the language and local conditions. Moreover, they come to Cuba with the expectation of returning to their own country after a few years. As a matter of fact, there is a continual change of personnel that is constantly interfering with the progress of the work. With the view of remedying this, the writer a number of years ago recommended to the Government the establishment of a high-grade agricultural college, where teachers, investigators, and farmers would be educated. This idea was partially adopted, but in place of one high-grade agricultural college six provincial schools of agriculture, or "granjas escuelas," have been established, with a two-year course of instruction. This is not sufficient to train investigators, but it will be the means of turning the attention of some young

[1] See Tercer Informe Anual de la Estacion Agronomica de Cuba.

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men to the openings in scientific work, and they will find the means of completing their education at other schools. For the purpose of training men for its own positions the station admits six student assistants, generally graduates of the Univerity of Habana, who already have some notions of the subjects which they wish to pursue. These young men are placed directly under the chiefs of the department, who teach them the technique of the profession which they wish to follow and guide them in their studies and in their work.

Mr. FORTIER. Mr. Chairman, Director Crawley in his paper has made a brief allusion to the subject of drainage. I would like to ask to what extent irrigation is practiced in Cuba.

Mr. J. R. JOHNSTON. Mr. Chairman, it is practiced only to a very small extent. There is one irrigation system in Central Constancia, in the Province of Santa Clara, in Cuba. Besides that, there is very little irrigation on a large scale. Farmers in many places have small pipe irrigation systems, but that is about all.

Mr. FORTIER. Is there any real need for irrigation? In other words, would it be of any great benefit in aiding crop yield?

Mr. JOHNSTON. There is certainly need for irrigation, but it is always a question whether the return would justify the expense. Sometimes there are unusual expenses that would be incurred in installing the system, but there is no question at all but that irrigation is necessary in many places. In the place I have referred to, Central Constancia, they have dry seasons or dry spells, and they believe there that irrigation is certainly yielding returns and is well worth while. There is no question but that among the truck farmers in the western sections, where the Americans have some tracts, there is a general feeling that the returns have amply paid them for their installation.

Mr. FORTIER. What about the sugar cane?

Mr. JOHNSTON. In the case I have mentioned, in Central Constancia, it is sugar cane I had in mind. I think it has paid them. It is simply a matter of getting it installed.

The CHAIRMAN. If there is no further discussion on this subject we will take up the final paper of the morning program, by President Kenyon L. Butterfield, of the Massachusetts Agricultural College, entitled "The agricultural college and the working farmer."

## THE AGRICULTURAL COLLEGE AND THE WORKING FARMER.

By KENYON L. BUTTERFIELD,

*President Massachusetts Agricultural College.*

The Congress of the United States in 1914 passed a law, known as the Smith-Lever Act, providing appropriations from the National Treasury for "extension work" in agriculture and home economics. Demonstrations, lectures, traveling

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schools, correspondence courses, and other forms of out-of-school education for farmers, old and young, are thus provided for. The machinery for carrying out the provisions of the act must be furnished in each State by its agricultural college, cooperatively with the United States Department of Agriculture, and the grant of funds from the National Treasury to any State is dependent upon an equal grant from the State treasury. The grants progressively increase by annual increment. When the law is in full operation the annual expenditures under it will aggregate not less than eight and possibly may reach nearly ten millions of dollars.

Thus, in one great legislative act there is launched with ample financial support a measure which looks toward the complete democratization of agricultural education. It is an effort to nationalize a system of popular agricultural education. It purposes to meet the needs of the masses of the farmers. It aims to reach the last man on the soil.

What is the significance of this huge piece of educational machinery? Why so much attention to the man on the land? For we must remember that this law adds to what was already a really great system of agricultural education, public support of which has not been niggardly. A gigantic national department of agriculture, a sisterhood of over 60 State agricultural colleges and 50 experiment stations, a long chain of farmers' institutes, a multitude of agricultural schools, and many other publicly supported agencies were at work before the new law was passed. Evidently our people believed that an even greater educational effort was necessary in order to place our foundation industry on a secure basis. The real significance of the new law is found in the fact that it is part of a new rural policy gradually evolving to meet new issues; it is a statesman's measure of a national need, aimed to invoke the most fruitful single force for progress, popular education.

This paper is an attempt to answer the question, What are some of the fundamental educational and social relationships of extension work in agriculture? To do this we must first briefly review the older rural policy of this country.

The agricultural policy of the United States during the nineteenth century had three chief aims: (1) To bring all available land into cultivation; (2) to place land-owning families on relatively small holdings; (3) to make the farmers skilled producers.

Our land-grant and homestead laws were designed to accelerate the migration from the East and from Europe and to fill up the West with independent farmers. The educational enterprises of State and National Governments fostered the development of skillful farm practice based on the researches of modern science.

This policy has not been completely successful. While the so-called "free lands" are relatively scarce, there are immense areas of our domain still comparatively unproductive. The land-owning man on the medium-sized farm, though for a long time the typical American farmer, is gradually giving way to the tenant, and statistics of yields per acre show small success in comparison with the more intensively cultivated European lands. Indeed, during the past 10 or 15 years there has been a growing restlessness on the part of the farming people. The increase in land values has induced constant migration to cheaper lands. The older lands have gone, as a rule, into the hands of the wealthier farmers, or into the possession of bankers or of business men with money to invest, who took the land largely on the speculative basis, trusting it would further increase in price. Larger farms and the beginning of a landlord system

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became inevitable. High prices for land have prevented men without capital from owning land, and tenancy has increased rapidly.

Moreover, the distribution of agricultural products has been very unsatisfactory. This was due in part to the development of farming land much beyond the needs of the urban demand for food in the regions of food supply, thus necessitating long shipments to reach a market, and in part to the fact that highly specialized crops have been grown at points far distant from the large markets. The increased prices which consumers pay for their food have not always been reflected in the prices received by the farmers, while the farmer has felt the effect of higher wages, not only in paying his own laborers, but in the cost of his purchased supplies. In many regions the old community life has broken down, and even in some cases where individual farmers have grown wealthy rural civilization has grown poorer. The urban drift has revealed many sinister aspects.

What has just been said would be distinctly an unfair portrayal of the farming status in this country if it were not added that in many respects our agriculture in the aggregate and in some regions was never so prosperous as it is to-day. The total figures of farm values and production are gigantic. The use of the automobile by farmers is a sort of barometer of farm business conditions. Nevertheless, we are in a period of transition in which vast economic and social changes are portended. The old rural policy has done its work, and we sorely need a new policy. Into this important transitional period has been projected this new extension service for the working farmers of America, to be administered by the agricultural colleges. Evidently a set of fundamental relationships is being established between our agricultural colleges and our working farmers. To put the matter in question form, what are some of the main elements in the new American rural policy that are to be forwarded by this new educational agency, the extension service of our American agricultural colleges? There are perhaps four of these elements that stand out for special consideration at this time.

1. *The conservation of soil fertility.*—That the conservation of the soil of any country is a fundamental national problem is a truism, but it is a truism that has had practical recognition on a national scale but a short time. The practice of our own people, as in the case of all other peoples on new land, has been to permit the individual to exploit the soil for his own benefit. Europe was forced some years since to treasure and revive her soil resources from the national or public point of view. It is a North American fault and, it may be suspected, a Pan American fault that the soil has been used primarily for individual gain rather than to the national interest. The interests of the individual are not always the interests of the State. In the case of the soil, individual interest means immediate returns. National interest means effective present use with full reference to ultimate values. Conservation, then, is not merely a method of soil treatment based on scientific knowledge; it also has in it a moral element—the duty of the individual to the Nation, the duty of the present to the future. It is evident that we have not yet developed to a very high degree this sense of obligation on the part of those who till the soil, but it can not be ignored. Rather it must be distinctly recognized in all our education and legislation.

Laws are indispensable to the successful control of water powers, mines, forests, in the interests of all the people; law is of little avail in saving soil power. Doubtless there may be useful laws regulating the relations of landlords and tenants, or concerning drainage and irrigation; but the one outstanding element of a successful policy of conserving the soil is education. We

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must gradually develop a body of knowledge, a type of practice, and a moral sense which will, in addition to such laws as may be necessary, result in the best possible use of the soil. There is, of course, implicit in the phrase, "the best possible use of the soil," the idea that the soil is to be used for growing the materials of food and clothing. Food plants, trees, wool and cotton, hay and grain, milk and meat, must come out of the soil in sufficient abundance for human need. Use, not idleness, is the soil's province. The best use of each acre of land in any country varies with conditions—with demand, transportation, competition from other countries, with the skill and instincts of the farmers themselves. Thus in practice this best possible use of the soil must be in a sense an adjustment, a compromise, a fusing, with respect to the interests of the particular man on the soil and the interests of the whole people, both present and future generations.

If education is the essential thing in soil conservation, it must reach all who till the soil; otherwise the result is only partial and fragmentary. We can not have complete conservation of soil resources until we have complete education of the soil tillers. The present task of our agricultural colleges is to assist in educating six or eight millions of American working farmers to conserve American agricultural resources.

2. *A profitable farm business.*—Not only must soil fertility and power be conserved, but agriculture as an industry must be reasonably profitable to those who follow it. This also is an indispensable requisite in national rural planning. We can not safely exploit the soil; no more can we exploit the soil tiller. He must receive a fair reward for his efforts. If he does not he will either abuse the land or he will be an inferior on the land. He will not do his best with the land if he stays on it, nor will he do his best with himself.

The main elements in a profitable agricultural business are perhaps these:

(*a*) Skillful farm management, by which the producing factors of land, labor, and capital are best combined to meet the economic situation which confronts the farmer.

(*b*) Facilities for credit that give the farmer access to the money market on terms at least as good as those enjoyed by other groups needing capital. These facilities imply mortgage credit based on collective land security, long-time loans with gradual but regular repayment; personal credit that meets seasonal needs—both forms of credit utilizing the spare capital and the good character of the farmers themselves, as well as the capital of the general investor; such an adjustment of supply of credit to the demands of the landholder as shall discourage the purchase of land for speculative purposes and encourage ownership by the man who works it and lives on it.

(*c*) The ability to purchase supplies and to utilize modern machinery on terms that lower the cost of production to the minimum.

(*d*) A scheme of distribution that gives the farmers rather than the distributors the benefits of the changes of the market. At present the farmer chiefly suffers from the maladjustments of demand and supply, while rarely reaping the advantages of adjustment. Of course a better adjustment of demand and supply is itself a requisite, as well as a simplifying of the machinery of distribution from original producer to ultimate consumer.

(*e*) A more complete system of protection against fire, flood, storm, wind, and all other foes, physical, biological, and human, that now prey upon the individual farmer.

(*f*) A better organization of means of investment of the farmer's profits than now prevails.

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In all these enterprises there are two possible principles of action—one, the principle of service to the farmer by specialized agencies that may deal with individual farmers or groups of farmers. These agencies are banks, commission houses, insurance companies, transportation agencies, and the like. The second principle is collective action on the part of the farmers themselves. The furnishing of credit, the purchase of supplies, the selling of products, insurance, the reinvestment of profits—all yield themselves to the collective or cooperating principle. Probably both principles will be invoked for some time in the future, the collective method gradually gaining ground.

These details of the problem of a more profitable agricultural business have been recited to give point to an observation that becomes vital in our consideration of the relation of the agricultural college to the working farmer—namely, that education, not management, is the function of this educational system. All these factors in farm profit must be managed by the farmers themselves or by their acceptance of the services of specialized agencies. The province of the educational institution supported at public expense is to investigate, to teach, to demonstrate, perchance to advise, but not to manage. Obviously this is a most important limitation on the function of the educational institution. It marks the Rubicon of appropriate activity on the part of our agricultural colleges; but this fact does not minimize the significance of this second great task of popular agricultural education—namely, to assist the farmers to a profitable agricultural business. It should be said that the question of governmental activity in these matters is not a part of this discussion, except that part of Government represented in the agricultural colleges.

3. *Maintenance of an adequate individual and neighborhood life among farmers.*—Neither soil conservation nor farm profits of themselves solve the rural problem. Out of this conservation of the soil and out of this better business there must come also a higher grade of people upon the land; at least, we must not have a lessening of the quality. Half our people reside on the land to-day; a third of them get their living directly from the land. Even under a growing urbanism probably not less than one-fourth of the people of the United States will always live directly on the land. This element of the population must be intelligent citizens as well as intelligent producers. They must have a satisfying community life. They must participate in an ongoing civilization. They must not be an inferior group. They must retain their status in the political world. They must have their own organs of public opinion and group expression. They must have a share in the common energies and activities of the Nation. They must have views in regard to large policies, not only as concerns their own interests, but the common national interest. They must be a part of our great American civilization and must be a strong, virile people.

The elements of a good farm life are not obscure. They may be summarized as follows:

(*a*) A farm home that conserves the physical vigor, the mental development, the moral character, and the spiritual insight of all members of the family, whether workers or growing children, and that plays its part in developing a rich community life.

(*b*) A mechanism of communication within the community and with other communities that serves both economic and social needs.

(*c*) A system of rural education that gives a sound foundation in the recognized elements of the efficient worker, the intelligent citizen, the high-minded man.

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(*d*) A conservation of the health of the people; proper provision for public sanitation.

(*e*) Machinery of a local government at once honest and effective for large community ends as well as for maintenance of order.

(*f*) Ample recreation, native rather than exotic; spontaneous, but directed for the young, self-expressive for the mature.

(*g*) A rural art that develops the full beauty of the farm environment, making beauty of dwelling, roadside, field, and broad landscape, an asset of farm life recognized by the farmer himself.

(*h*) A rural culture that appreciates the full meaning of life and seeks constant development of mind and spirit through work, books, nature, human companionship.

(*i*) Moral conditions that make for training of children in the best habits of conduct.

(*j*) The religious motive that idealizes work as service in a great cause, land ownership as social responsibility, and life itself as a sacred trust.

Here, too, there are limitations to the work of an educational institution—as, for example, in the inculcation of religious truths. We can not run the farmer's farm for him; we can not manage his business for him; no more can we regulate a whole community of farmers. Our province is to teach—to teach the principles underlying these broad needs. The great consideration is that our teaching shall not stop with the production and distribution of things, but must concern itself with the development of human efficiency and the relation of men and women to one another and to permanent national welfare.

4. *The more complete organization of agriculture and country life.*—In the old days the individual farmer in this North American country took his family to a relatively small farm, grew their living, improved the land, made a home, educated his children, and helped to conquer a continent for civilization. After a time he did something more—he grew things to sell. He sold these things as an individual, first by barter, then for cash. Gradually the agricultural market developed. At one end of it was this individual farmer; at the other end of it was a buyer, a distributor. Gradually these individual buyers and distributors grouped themselves more or less definitely, and there came into being what we call "the market," an impersonal but very real and controlling factor. The farmer, still an individual, dealt with this new machine, and necessarily he was handicapped by it. He found fault with it and finally rebelled . This was the beginning of the great farmers' movement in the United States in the seventies and eighties. A good deal of this effort on the part of the farmers was misplaced, but in general it stirred the whole question of agricultural advancement by demonstrating that the time was fast approaching when the individual farmer, no matter how effective he might be as a producer, when he came to sell his product, when he came to buy his supplies, when he came to take his place in the industrial and commercial world—that the individual farmer was of slight account and that the only way by which he could maintain his freedom was by uniting with his fellows in collective processes and methods. Cooperation then came to the fore as a panacea. The movement had many deficiencies. Great organizations arose, some of which were successful for a time and then went to pieces. Some of them rode the storm and still survive.

This period was followed by one of great agricultural prosperity. During this time great currents were setting in which for a while were obscured by



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the increased prices for food produced and by the increase in the value of the land. More and more we are coming to see that these currents are very real and many of them menacing. We find still that the individual farmer is handicapped, and he realizes that he has not taken due advantage of the idea of organization, which has been so revolutionary a process in connection with business and with labor. We are coming to a time, therefore, when the idea of rural organization, namely, the development of a comprehensive correlation of all agricultural and rural life interests, is indispensable.

A multitude of agencies has arisen in obedience to the recognition of the need of organizing agriculture and country life, which may be grouped as follows:

1. Associations to improve production—live stock, dairy, horticultural societies.

2. Associations to improve marketing and exchange—credit unions, cooperative selling societies, mutual insurance companies.

3. Associations to improve country life—the church, women's clubs, improvement societies.

4. Associations of a general or inclusive character, like the Grange and the Farmers' Union.

5. Agencies supported at public expense—administrative, like boards of agriculture, of education, and of health; educational, like special agricultural schools, county farm bureaus, agricultural colleges, and experiment stations.

6. Urban agencies, such as manufacturing concerns, banks, and boards of trade.

Obviously there is need for correlation of effort. The functions of each form of association must be recognized, and while the labor may be divided, all agencies must cooperate in a common task.

The local rural community should be a social unit or organism of great vitality. Its needs should be studied, and plans made for its upbuilding. There should be state and national rural policies. We must know all the conditions and resources of agriculture and country life. We must understand just what we have to deal with. We must adapt our agriculture to these resources, or else see to it that we change the conditions under which things must be done. There must be adequate plans for improvement and adjustment. We must have a wide policy—a big idea of what we are to do with these resources. We must have a correlation or coordination of all those factors and agencies that are being utilized as a part of the machinery of business and of common life together. This correlation is the crowning thing in the organization of agriculture and country life.

Again, we find that the agricultural colleges may not manage the farmers' tasks. This work of rural organization is a cooperative affair of great magnitude and delicacy. The teaching of the need of correlation, some measure of leadership in securing it, does, however, devolve upon the agricultural colleges, largely through their extension service.

We have, then, before us these four problems from the national point of view: The conservation of the soil, the development of an agriculture profitable for the masses who follow it, a high-grade rural life, and a more comprehensive organization of all the agencies that can be developed to strengthen and work out the total rural problem. Education is unquestionably a prime requisite for meeting these issues. The nation recognizes the need for a great piece of constructive statesmanship.

So we find the agricultural colleges developing a new and serious responsibility under the new extension act. They become in a sense the irrigation

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ditches that distribute the life-giving waters from the storage reservoirs, and turn them over the small units of rural endeavor. They become the great distributing agencies for all those investigations and teachings that are worked out through and by the experimenters and the teachers of students. The task of meeting these significant national problems is to be handled largely through this new piece of machinery—the extension service of the agricultural college.

The thought of this responsibility of the colleges brings us to the summary of our subject—the relation of the agricultural college and the working farmer. The agricultural college through its extension service, utilizing and cooperating with all agencies that will help, will teach all of these four lines of effort. It will emphasize the responsibility of the farmer for his land, methods of conserving soil fertility under a system of maximum production. It will demonstrate better means of distribution. The Government can not participate in the farmers' business, but it may go very far in an educational way to show how this problem can best be worked out with justice to producers and consumers. The college will teach the principles of an adequate rural life, for we will not ignore the problems of the home. We will take up the questions of the rural school. We will help to bring in proper rural recreation. We will make sure that the health and vitality of the farmers are conserved by proper sanitary measures. We will not neglect the beauty side. We will have a development of the rural arts. We will look out for the enlargement of an intellectual life that is sound and wholesome, a real rural culture. Finally, we will point out ways and means by which conflicting or rival interests may be correlated into the great organization of agriculture and country life that we so much need.

Thus the agricultural college becomes a national agency of statesmanship. It is to be one of the great channels through which the working farmer is brought into touch with all those powerful economic forces, those rich intellectual achievements, and those broad areas of knowledge that may help in working out the fundamental problems of rural civilization.

The CHAIRMAN. It might possibly be interesting to some who are here if I should make a brief statement about the system of cooperative agricultural extension work as it is at present developed in this country.

This system is being developed in a national way through the close cooperation of the United States Department of Agriculture and the State agricultural colleges. The Department of Agriculture not only acts as a clearing house and agency for information on all subjects relating to this extension system, but it also participates in a substantial way in the different branches of the service. It does this through its bureaus, which, having accumulated large funds of agricultural knowledge, are now undertaking to carry these out to the people through the agencies established for extension service in the different States. It does it also through its administrative duties under the Smith-Lever extension act, under which the plans for this work must be submitted to the department each year in advance and approved by the department before they are put into operation by the colleges. You will see that since the United States Department of Agriculture has varied and vital duties in connection with this

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extension system, we are prepared to build up a truly national system for the benefit of the masses of our farm people. While there will be differences in each State and each college will work in a free and somewhat independent way in the development of its plans for this service, they will, in large measure, be coordinated and brought into what truly may be called a national system through the instrumentality of the United States Department of Agriculture.

For the purposes of this service especially, the United States Department of Agriculture has created what is known as its "States Relations Service," which has charge of all the business of the department in its relation to the agricultural colleges, including both research in its connection with the State experiment stations, the teaching of agriculture through a small division which investigates the problems of teaching agriculture in the schools and colleges, and extension work through two offices, one for the Southern States and the other for the Northern and Western States.

For the purposes of the extension service, the Department of Agriculture has at present an annual appropriation of about $1,000,000, which is spent in its administrative business and in projects in cooperation with the State agricultural colleges; and that money is directly administered through the extension offices of the States Relations Service. This is in addition to Federal, State, and county funds administered through the State agricultural colleges, amounting this year to nearly $4,000,000.

Under the cooperative arrangements with the States each college of agriculture has a division known as the agricultural extension division or service, and at the head of this is an officer, commonly called the "director," who is made responsible directly for the administration in the State. This officer is a member of the faculty of the agricultural college and subject to the president of the institution and the board of trustees; but he is also in cooperative relations with the United States Department of Agriculture.

Under this State director there is a corps of specialists located at the college. These specialists have functions with reference to different branches of agriculture and home economics, such as animal husbandry, horticulture, foods, household equipment, etc. They go out from the college to spread among the people the information which the college has, through short courses of instruction which commonly are called "movable schools," through contact with the officers of the extension service in the counties, through the preparation and distribution of publications, and in other ways.

Under the director of extension there is also an officer called a "State leader of county agents." He has under him a force of men and women in the several counties of the State, who are in immediate

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contact with the farmers. These persons are commonly called "county agricultural agents," though in various States they have different names. The county agent first appointed is usually a man, and it is his business to get in touch with the farmers of his county and to organize them into groups through whom he can work, for obviously one man in the county can not work effectively by simply personally visiting all the farmers in the county. He carries on, with the aid of these groups and individual farmers, demonstrations of improved crops and methods of culture, improved live stock, and various things on the farms of individual farmers, and as these demonstrations proceed he gathers the neighboring farmers at meetings, at which these demonstrations are observed and explained. He also, through his office in the county, is able to give advice to people who may come there or who may invite him to go to their farms. Thus he aids the farmers in a great number of different things.

Associated with him there should be, and in a considerable number of counties there already are, women agents who deal with the women and girls on the farms. Usually it has been found desirable to approach the women through the girls by first forming clubs of girls for the purpose of carrying on such things as the raising of some vegetables or fruit which they may can for home use or for sale. Groups of girls engaged in that work are also given some simple instruction in various matters relating to farm work, garden work, and home life. Then, through the girls, an entrance is gained into the farm home, and the women become interested. Organizations of women are formed, and thus the woman agent is able to work finally, just as the man agent does, through groups of women. She endeavors to aid them in any way that she can to improve the conditions of their farm homes and surroundings, and especially to give them some economic interest in the business of the farm by encouraging them in the raising of poultry or garden material or the making of canned goods, which they can sell and get some money for themselves; for we find that one of the greatest difficulties that farm women have to meet in their home conditions is that they do not have control of as much money as they need. We can get more influence over them and do them more good if we approach them through this economic agency, encouraging them in ways which will give them some profit, and thus enable them to start in improving the home life.

In order to carry out this system it is necessary to have a certain amount of money contributed by the local community. That is done sometimes through local initiative on the part of the farmers or their business friends, who contribute a certain amount of money to start the enterprise in the county. This money is usually given toward the salary and expenses of the county agent. But wherever

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possible those expenses are put on a public basis by getting the county commissioners or other public officers in the county to make a contribution out of the taxes of the county toward the support of the county agent. This is coming to be the general means of getting the local funds.

Then the farmers of the county often form a county organization, which in many cases is called a farm bureau, and that county organization takes part in the selection of the county agent. Of course, we do not want to put into a county an agent who is not acceptable to the people there, and therefore we work with the farmers to find out what kind of a person, and in some cases who individually would be acceptable to them; and as far as can be, we meet their wishes in that regard.

These county bureaus sometimes not only carry on this extension work, but they themselves organize into a buying or selling organization. We do not permit our county agents actually to engage in the buying or selling of farm products. They may advise the farmer how he can work cooperatively, but they are not to carry on his business.

In that way we have already organized quite a complete system, beginning with the organizations of farmers and farm women and children. These organizations work with the county agents, men and women. Back of the county agents is the State leader of county agents, to look out for them in the State as a whole administratively. Back of the State leader is the organization at the college, consisting of the State director of extension and the specialists, who go out to help the county agents. And back of the State organization is the national agency in the extension offices of the States Relations Service of the Department of Agriculture and the specialists from other bureaus of that department.

This system has been in operation only about a year and a half, so it is all in the making; but we have had somewhat similar enterprises going on for about a dozen years, and we have organized the present more complete system on the basis of the older operations. Thus we already have in the United States about 1,200 counties organized with a man county agent, and about 450 counties in which there is also a woman agent.

In the Southern States we also take into account the difference in races, and we have already a considerable number of agents who work especially among the colored people.

I think I have taken more time than I ought to, but I thought possibly you would be interested in knowing about the present development of the system to which President Butterfield referred in his paper.

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Is there any comment or question?

Mr. MATTERN. Mr. Chairman, I have been very much interested in your comments on this able paper. Do I understand that the main trend of this extension is to bring the work of the investigator down to the farmer, or does it in any way aid to train and educate the farmer boy to the point that he will appreciate this information that comes down to him? In other words, the boy or the girl between 12 and 18 is bound to have his mind fastened on something. Is he in the country school fastening his mind on the fundamental principles that will enable him to appreciate this information when it comes down to him? Is there anything in this system that aims to do that sort of work?

The CHAIRMAN. We are trying to do both things—to carry out information to the farm people, both adults and youths, and also among the youths particularly to encourage their more systematic education. These clubs to which I have referred—boys' and girls' corn clubs, cooking clubs, pig clubs, and so on—are in a great many cases associated with the rural schools, and the teachers of the schools are taking part in the organization of the clubs and in their work. Then we get the members of those clubs together and give them a certain amount of instruction. But we also encourage the teaching of the simple elements of agriculture in the rural schools, and a great many schools are taking that up. We also encourage the boys and girls to go on further and to get more education. In these clubs it is common to give prizes, and one form of prize which is becoming more and more popular is a scholarship to a short course at the agricultural college. Of course, that would be for the boys and girls from 14 years up. Hundreds of boys and girls now go annually, through securing these prizes, to the various agricultural colleges of the country, for a short course of two weeks or a month, and thus get some instruction and also some inspiration to get further instruction.

Mr. FULLER. Mr. Chairman, I have noted the working out of this extension service in Arizona, and it occurs to me, along the lines suggested by the gentleman a moment ago, that it might be of immense importance to the extension service if the schools were encouraged to instruct the pupils in the importance of this work of the various farm advisers, letting them know the purpose of these various agents in the field, so that in a community they might look to them more in an advisory capacity. I notice there are certain sections where the farmers are not inclined to receive these agents in the proper spirit and in the proper light, and I believe if the young students or pupils could appreciate their importance and use their influence in their homes, it might tend toward increas-

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ing the interest of the farmers and the interest they would take in these various agents.

The CHAIRMAN. You mean that should be done through the school authorities?

Mr. FULLER. Yes; as a part of their work, I think, to bring out or mention at various times the fact that these agents are in the field and that their purpose is to instruct and encourage the farmers in better agriculture.

The CHAIRMAN. Undoubtedly more of that can be done as time goes on. So far the principal reliance for that has been, I think, on the county agents themselves. That is, as they go about the county they are supposed to get in touch with the county superintendent of schools and with the teachers and to give them information about this system and to encourage them so far as they can. The system is so new that undoubtedly many teachers have not been reached and therefore have not taken any interest in it.

Mr. MARSHALL. Mr. Chairman, I would like to ask if you would care to go a little further into the relationship between the various departments' work that you mentioned in the State colleges and experiment stations and the corresponding specialists in the extension department; that is, the relation of the extension director and the heads of departments in the selection and control of the work of these extension specialists? What is the plan that has been worked out in that respect?

The CHAIRMAN. We actually have different plans in different States, but in a general way perhaps this may be said: It is expected that the extension workers, whose headquarters are at the college, will be under the administration of the extension director as far as their time spent in extension work is concerned. They should be, however, and in many cases are, members of the subject-matter department to which they properly belong; that is, if there is an extension worker in animal husbandry, he should be a member of the animal-husbandry department of the college, and he should, as far as the subject matter of his teaching is concerned, be responsible to the head of that department, so that when he goes out to teach he will teach things which can be approved by the college in general. That makes a somewhat complex system of administration, but it means more cooperation all along the line, and that is really the big thing in our extension system if we can work it out. It will be a fine example of cooperative effort, because it is a very complex system, and unless the people work well together we shall not get on at all.

Mr. TRIMMER. Mr. Chairman, one of the things I have long been thinking about and observing is the fact, it seems to me, that there

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are a great many of our very best boys who fail to get a college education, and often a high-school education, because the schedules of time for holding school are adjusted to city ideas. In North Dakota our boys are free from about the middle of October until the middle of March, and we meet their needs by the ordinary farm husbandry and similar courses. A good many of the boys, I think, fail to go on into college and fail to get education as they should. I have discussed this question somewhat with the idea that it should be possible for our boys to go right up to high school and college, attending school about half the year, from October to March. I have always met the objection that if you get young men to teach these boys you will have to have them for the year, and they will be at work only six months. I have often wondered if there is not a possibility of cooperation here, so that men at work in the summer in the department could give instruction during the winter and in this way help these young people on the farm.

The CHAIRMAN. That is a very important question and a very difficult matter to adjust in view of the present condition of our educational machinery as well as the extension machinery. But I look forward to the time myself when the whole system of education for our rural people will be powerfully affected by the coming in of this extension service. The rural elementary schools in this country are at present lamentably weak, as we know, because they are taught very largely by young women and in many of our States have a comparatively limited term. If we can connect this extension service with the rural schools, so that we can have a great many more men who would live in the community the year around and who would give part of their time to teaching in school and part in the extension service, I think we will be able to develop our rural education in a much more satisfactory way. We already have some arrangements by which teachers, particularly in the scondary schools or the high schools, who devote part of their time to teaching agriculture in the schools, can devote the rest of their time to extension work among the farmers in the county. That has perhaps come about more in the South, where they are bringing in the high-school system in the rural districts for the first time and are forming county high schools. There it is possible under present conditions to make an arrangement in certain cases by which the teacher of agriculture in the county high school will also act as the extension agent during the long vacation.

Is there anything further? If not, I declare the meeting adjourned.

Thereupon, at 12.25 o'clock, the meeting adjourned.

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## SESSION OF SUBSECTION 7 OF SECTION III.[1]

RALEIGH HOTEL,
*Friday morning, December 31, 1915.*

Chairman, FAIRFAX HARRISON.

The session was called to order at 9.30 o'clock by the chairman.

The following papers were presented:

The advisability of collegiate courses on marketing and distribution, by T. N. Carver.

Improved transportation service for perishable products, by G. C. White.

Car-lot distribution, by J. S. Crutchfield.

Trading in grain futures, by L. D. H. Weld.

Transportation of perishable commodities: need of cooperation of shippers with carriers, by Eugene F. McPike.

Opportunities afforded the railroads of the United States for profitable agricultural development work, by T. F. Powell.

The extent and possibilities of cooperation, by C. E. Bassett.

### THE ADVISABILITY OF COLLEGIATE COURSES ON MARKETING AND DISTRIBUTION.

By T. N. CARVER.

*Professor of Economics, Harvard University.*

The subject of marketing is of considerable importance both as a branch of theoretical economics and as a problem in practical statesmanship. As a branch of theoretical economics it must occupy an important place in every scheme for the analytical subdivision of the subject matter. The classical subdivision of the subject matter under the four heads "Production," "Exchange," "Distribution," and "Consumption" will bear a great deal of elaboration. Marketing may come either under the general head of distribution or that of exchange. Distribution may in turn be further subdivided into distribution of products and distribution of incomes. A somewhat more accurate and logical subdivision, however, would be under the three headings, "Occupational distribution of products" (sometimes called functional distribution), "Territorial distribution," and "Personal distribution." Under occupational or functional distribution the object is to find out what determines the share of the total production of the community which goes to each occupation or to those who

[1] There was no stenographic report of this meeting.



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perform certain functions. Under territorial distribution the aim is to find out what determines where, or to what localities, the products find their way after they are made or produced. Under personal distribution the object is to find out to what persons or groups of persons products are distributed; that is, who gets the use of them. It is obvious that problems of territorial and personal distribution are largely problems of marketing.

There is another sense in which the problems of marketing would fall under the general heading of "Exchange." This heading has generally included the study of money, banking, and credit, and other devices and mechanisms for facilitating the transfer of ownership from one person to another. Anything, in fact, which has to do with the processes of bargain and sale has been taken up under the head of "Exchange." It is obvious, however, that there are many other factors involved in this process than are usually studied under the head of "Exchange." The lawyers have long recognized the distinction between fungible and nonfungible goods; that is, the distinction between goods which can be so graded and classified as to satisfy the buyer with a given quantity without regard to the individual units which make up that quantity and the goods which are not so graded and classified, and in whose purchase, therefore, the buyer is careful to select the individual units which meet his needs or suit his taste. Of course, from the purely legal point of view, this is a matter of the fulfilling of obligations and the meeting of contracts. Fungible goods are those with which the seller can fulfill his contract by delivering a given quantity without respect to the choice or selection of the buyer. This legal distinction happens to coincide pretty closely with the distinction between goods which can be sold on grade and those which have to be sold on inspection. A very little study will convince one that selling on grade is a very much more efficient method of transfer of ownership than selling on inspection. The establishment of grades and standards is quite as important in facilitating exchange as a monetary or a banking system. In fact, money itself furnishes one of the best possible illustrations of the advantages of selling on grade rather than on inspection. A gold coin, if melted down or hammered down into a lump, is worth approximately as much as the coin itself, provided you can find a purchaser. The great difference between the lump of gold and the gold coin is that the lump has to be sold on inspection, that is, the receiver must weigh and test it in order to satisfy himself as to its quantity and quality, whereas the coin literally sells on grade—that is, it has already been weighed and tested and the stamp is a certificate of quantity and quality. That which makes the coinage of money an economical thing for the Government to do may also make the establishment of grades and standards in other materials an economical thing for the Government to do, for the superior economy of selling on grade rather than on inspection shows itself in many other fields than that of money. Large-scale dealings in wheat, cotton, pig iron, etc., on very small margins of profit per unit are made possible only by the grading system, and it follows that the better the system of grading the lower the cost of transfer and the greater the economy to the people as a whole.

A very important line of inquiry in this connection might be started on the question of the function of the Government as the setter, or fixer, of standards. There seems to be sound economic reasons why the Government should coin money and establish weights and measures. These economic reasons are simply that they facilitate exchange and enable the processes of bargain and sale to go on with less friction and more economy of effort. The same reasons, however, apply with equal force to the grading of products, wherever grading is possible. It is quite as important that the buyer of apples shall be able to

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know what a "fancy" grade, an "A" grade, or a "B" grade may be, as that he know how much a bushel is. And it would greatly benefit the buyer and, in the end, the seller as well, if he were protected against false grading, just as he is now protected, after a fashion, against false weights and measures.

That clause in our Federal Constitution which provides that Congress shall have power to "coin money, regulate the value thereof and of foreign coins, and fix the standard of weights and measures," was an early recognition of the fixing of standards as a proper function of government. It is true that this specific provision delegated this particular power to the Federal Government instead of leaving it exclusively to State government, but this involves the assumption that some government must have this power. The assumption that some government, whether it be State or Federal, should establish grades, rests on as sound economic foundations as that it should fix the standard of weights and measures. Whether it shall be by the Federal or the State government is a problem for the constitutional lawyer rather than for the economist to decide. A system of grading is a system for determining and denominating quality, whereas a system of weights and measures is a system for determining and denominating quantity. In the process of exchange, quite as much friction, waste of effort, and loss occur from a lack of means of determining and denominating quality as from a lack of means of determining and denominating quantity. The principle of *caveat emptor*, let the buyer beware, would justify on economic grounds the absence of authoritative standards of weights and measures as easily as it would justify the absence of authoritative grades. As a matter of fact, it is economically sound only when it is impossible to determine authoritatively either quality or quantity.

This paper is not intended as a discourse on marketing, but rather as a discourse on the necessity of a study of the problem of marketing. These cases are mentioned merely to show how many new problems there are which need study and discussion. Another way in which the problem of marketing enters into the general scheme of theoretical economics is through the study of various forms of utility or methods of increasing utility. We have, to begin with, the three classical types of utility—namely, form utility, time utility, and place utility. The farmer, for instance, who grows wheat or who transforms certain material elements in the soil and atmosphere into wheat has produced form utility. The elevator which stores it and keeps it until it is more needed than it is immediately after harvest produces time utility; and the railroad which transports it produces place utility—that is, takes it from place where it is less useful to a place where it is more useful. It would seem that there should be a fourth type of utility added—namely, personal utility; that is, the increased utility that an article yields when it is transferred from a person who has less use for it to a person who has more use for it.

Marketing has to do with all these forms of utility except the first. Marketing has to do with storing, with transporting, and with finding the person or persons who want the article most and are willing to give most in exchange for it. Of these, however, it has most to do with the last—namely, personal utility. Incidentally, of course, in finding the persons who need an article it may have to be transferred to a different place, thereby acquiring place utility. Again, it may have to be stored, thereby acquiring time utility; but even in the same time and place the utility of an article may be greatly increased by being transferred from one person who has a surplus to another person who has a deficit.

It is clear, therefore, that there is a large place in the scheme of theoretical economics for the study of marketing, and that this study will be of the character which will try the intellectual mettle of the best students. It can not, therefore, be put aside as unworthy of the attention of educated men.

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As a problem in practical statesmanship it is rather obvious, is it not, that the prosperity of the country will depend quite as much upon the economy with which goods can be transported, stored, and transferred from one person to another, as upon the economy with which they can be produced. Adam Smith, who wrote the first great treatise on statesmanship under the title of "An Inquiry into the Natural Causes of the Wealth of Nations," laid his chief emphasis upon the importance of the division of labor. He showed in a manner which has never been improved the advantages of a division of labor where each locality as well as each individual does the thing for which it, or he, is best fitted, and exchanges products with places and other individuals who are likewise specializing on other things. But he pointed out with great clearness how strictly this division of labor was limited by the nature and extent of the market. This virtually means that unless these various specialists can exchange their products economically and without great waste of effort, the cost of exchange may be so great as to overbalance the advantages of the division of labor. It would be easy to point out historically how specialization and a division of labor, both individual and territorial, have followed very closely in the wake of improvements in transportation and communication. It might not be quite so easy to show how they have also followed in the wake of improvements of other marketing facilities; but it is just as true in this case as in the other. The advantages of specialization depend upon economies in exchange or marketing. Where marketing is easy and inexpensive, the advantages of specialization overbalance the cost of exchange. Where marketing is difficult and expensive, the cost of exchange overbalances the advantages of specialization.

Since we are generally convinced that progress comes with specialization, if we can also be convinced that specialization comes with improvements in marketing, we can not escape the conclusion that progress comes ultimately through improvements in marketing. In somewhat concrete, tangible form it amounts to this: If the cost of marketing is so great that Farmer A, who grows wheat and buys shoes from Shoemaker B, finds that the cost of getting his wheat to Shoemaker B and getting the shoemaker's shoes back to himself is so great that he could have had better shoes with less labor by making them himself than by growing the wheat to exchange for them, then Farmer A will do better to grow less wheat and make his own shoes. But if the marketing of wheat is fairly inexpensive and likewise the marketing of shoes, then he will find it very much more economical to spend his time growing wheat and exchanging his surplus wheat for shoes; that is, with the same amount of labor he will be able to have better shoes, or have equally good shoes with less labor by this process.

We are convinced finally that a division and specialization of labor are essential to our economic progress and prosperity; and if this becomes economically possible only by increasing the economy of exchange and improving the facilities for marketing, then nothing more is needed to show that as a matter of practical statesmanship the problem of economical marketing lies at the root of all economic progress.

The only question that remains is as to whether colleges and universities are the proper places for the study of marketing. The reply is that colleges and universities are the proper places for the study of any problem which is, in the first place, of such profound importance to the welfare of the community as the problem of marketing, and, in the second place, of such difficulty and magnitude as to challenge the best efforts of educated men.

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# IMPROVED TRANSPORTATION SERVICE FOR PERISHABLE PRODUCTS.

By G. C. WHITE,

*Specialist in Charge of Transportation, Office of Markets and Rural Organization, United States Department of Agriculture.*

## INTRODUCTION.

Within the memory of men now living, the city of a million souls consumed, during a small portion of each year, comparatively small quantities of perishable commodities which had been produced within a decidedly circumscribed area and transported for the most part very short distances by crude methods. The modern city of an equal population includes in its daily menu the products of all countries, all climes, and all seasons. This fact differentiates the civilization of today and distinguishes it by an excellence superior to any hitherto known.

Many, if not most, of the types of vehicles and methods of conveyance devised in the past are still in use in some parts of the world. They furnish the student an interesting object lesson in history and a practical comparison of different kinds of transportation service. The substitution of one kind for another does not necessarily mean improvement merely because the system discarded happens to be of earlier origin. Many circumstances must determine the advisability of change. The determining factor is the economic cost to the community served.

This paper will be confined to a discussion of the most advanced methods of transportation used at the present time by the civilized nations of the world. As to improvements actually accomplished, attention will be called for the most part to those of the past decade. Suggested improvements, not yet adopted or in general use, will be referred to and discussed as their importance warrants.

The people of the United States of America take a pardonable pride in the belief that their transportation system surpasses others in efficiency, but it by no means follows that practices which are successful here could be transplanted to other countries and secure such good results under conditions, many of which, economic and otherwise, are so very different. If this paper appears to be concerned disproportionately with transportation practices on the North American Continent, let it be attributed not only to the fact that the author's experience and observation have been confined to that section but also to the great dearth of literature from other countries bearing on the specific phase of transportation under consideration.

## DEFINITION OF PERISHABLE PRODUCTS.

The noun "perishable" is defined as "property which from its nature decays in a brief time, notwithstanding the care it may receive."

Mr. J. M. Culp, of Washington, D. C., vice president of the Southern Railway, in his report (1) on perishable goods submitted in 1910 at the eighth session of the International Railway Congress, convened in Berne, Switzerland, speaks of "property susceptible to early deterioration and decay," and classifies it under the following heads:

Products of animals: Fresh meats, products of packing houses or abattoirs.

Dairy products: Butter, cheese, milk, dressed poultry, eggs.

[NOTE.—All number references in the text are to the bibliography.]

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Products of agriculture: Highly perishable fruits and vegetables, ordinary perishable fruits and vegetables, tropical fruits.

Miscellaneous: Fresh fish and sea foods, beer in kegs.

The American Railway Perishable Freight Association's Circular No. 27C (2) defines perishable commodities as "any articles requiring refrigeration, ventilation, or other protection against heat or cold." No attempt is made to catalogue by name each and every article intended to be included in such a definition. Of the list of 50 given, 9 are nonedible substances, 4 are commercial liquids not used as beverages, 7 are mineral waters and other liquors used as beverages, and 9 are general commodity names, each including a number of specific food products.

"Perishable products" in this paper will mean such articles as contribute to the sustenance of man and will be restricted to "dairy products," as defined by Mr. Culp, fish (including sea foods), fruits, vegetables, live poultry, and such live stock as is slaughtered for food. Live poultry and live stock are included by reason of the fact that their transportation demands special facilities and various kinds of special service.

## DEFINITION OF SERVICE.

As it relates to transportation, service is defined as the means of supplying something which is in general demand. The perishable products under consideration contribute directly to the support or amelioration of human life. The things in general demand regarding them are that they be transported from the point of production to the point of consumption as economically as possible, in the quickest time possible, and with the least possible deterioration.

As was so well said by Mr. Culp (1), "a disposition to full cooperation on the part of the producer must be assumed and relied upon. The highest state of perfection in the transportation of perishable property is wasted effort in the absence of proper preparation for its shipment and proper facilities for its receipt and distribution at destination." Account must be taken, therefore, of many things which, for some purposes, may be regarded as having no connection with transportation, but which, for the purpose of this paper, are so inseparably connected with the efficient transportation of perishable products as to be regarded as essential elements of transportation.

## REFRIGERATION IN TRANSIT.

Mention of the transportation of perishable commodities instantly brings to mind the refrigerator car. While it has, of course, played a most important part in the distribution of foodstuffs, the almost undivided attention given it has resulted in our losing sight of many other things that deserve consideration.

So far as our information goes, the refrigerator car had its origin in the United States. As far back as 1868 fruit was transported in this country partly iced (3). Its transportation in carload lots, under refrigeration, from California began in 1888 (3). It is believed that the first fairly successful refrigerator car for the transportation of meat (4) was built at Detroit, Mich., in 1871. By 1880 the transportation of meats under refrigeration was established as a practical commercial possibility (3).

Refrigerator cars are in use at the present time in Canada, the United States, Mexico, Argentina, Brazil, Australia, India, South Africa, England, France, Germany, and Russia. There are doubtless other countries where they are used,

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but, as already noted, dearth of literature bearing on the subject makes this belief difficult of verification.

As illustrating the development of their use in the United States, some figures may be taken from the statistical reports of the Interstate Commerce Commission. During the 11 years beween 1902 and 1913 the population of the United States increased approximately 25 per cent; the railroad mileage increased 23 per cent; the tonnage of perishable products increased 44 per cent; the number of freight cars of all classes increased 47 per cent; the number of refrigerator cars increased from 18,222 to 43,889, or 138 per cent (5–6).

These figures include only the cars owned by the railroads (7). Many cars are owned by the private car companies and used by the railroads under contract. The private car companies are not common carriers, within the meaning of the law, and make no reports to the Interstate Commerce Commission.

The total number of refrigerator cars in use in the United States at the close of 1913 was in excess of 100,000 and included approximately 38,000 of private (as distinguished from railroad) ownership and about 17,000 belonging to companies controlled by the railroads. Thus it will be seen that the total number of refrigerator cars in use was in excess of 4 per cent of all the freight cars in service.

In computing the tonnage of perishable products from the statistics of the Interstate Commerce Commission the following items, shown therein, have been included: Fruits and vegetables, live stock, dressed meats, poultry, game, and fish. It should be mentioned that in 1902 the tonnage of perishable products handled by the railroads of the United States was 3.4 per cent of the entire tonnage handled, and in 1913, 3.1 per cent. It should be noted also that in 1902 the number of refrigerator cars of railroad ownership in use was 1.2 per cent of the total number of freight cars, while in 1913 it was 1.8 per cent.

In these computations the year 1902 was selected (5) because in that year, for the first time, the Interstate Commerce Commission, in its equipment statistics, segregated the different kinds of freight cars. The year 1913 was chosen (6) because the statistics for that year are the latest available.

The first session (21) of the International Congress of the Refrigerating Industries, convened in Paris in July, 1908, as well as the third session (28), convened in Chicago in September, 1913, gave considerable attention to refrigeration as it relates to transportation both by rail and water. It would appear not improbable that in the course of time, as their population increases and economic conditions become such as to demand it, we shall see in such countries as Russia, Africa, Australia, and South America a development of the refrigerator car surpassing anything known at the present time in the United States. They have in great degree the first essential of long distances, within the confines of a single State, separating producing areas from populous consuming centers. Such conditions do not prevail in England nor in most of the countries on the continent of Europe, where other factors also have operated against a rapid development of refrigerator-car service.

*Refrigerator cars.*—The refrigerator car in use in the United States conforms in design and construction to the standards prescribed by the Master Car Builders' Association (8). It differs from the ordinary box car in being insulated and provided with ventilators, ice bunkers, drain pipes, false floors, and meat hooks and racks. It is not to be understood that every refrigerator car is thus fully equipped throughout. Certain cars used in New England for the transportation of milk have no ice bunkers, the ice being placed on top of and around the milk cans. Cars for dressed beef are equipped with hooks and racks, which makes it impracticable to use them for fruits and vegetables.

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In the evolution of the refrigerator car and its prototype, the box car, the carpenter has been replaced by the mechanical engineer, and the genius of the latter has been supplemented by that of the refrigeration engineer. More rapid progress would have been made in the past if the refrigeration engineers had had a more intimate knowledge of railway requirements and operating conditions and if the railroad engineers had known more about refrigeration. This difficulty is becoming less pronounced with the increasing tendency of the railroad companies to build and operate their own refrigerator cars.

Some of the latest types of refrigerator cars, with more and heavier insulation and steel underframes, weigh approximately 50,000 pounds and have a capacity of 90,000 pounds or more. This results in an unusually high proportion of dead weight to paying load. A weight capacity of 90,000 pounds, with a space capacity (13) of from 2,000 to 2,500 cubic feet, is far in excess of the possible weight of perishable products that could be loaded into one of them and still further in excess of the average weight of such commodities actually loaded in them. The weight capacity of such cars is of no interest to shippers, but rather indicates the strength necessary in any car for it to withstand the stress and strain to which it is subjected in trains of 2,000 tons and upward handled by modern, powerful locomotives.

Most refrigerator cars for the transportation of fruits and vegetables are used as ventilator cars also, when the weather is not sufficiently warm to make refrigeration necessary. Gases and heat given off by the contents of the car should be removed and replaced by purer and cooler air from the outside. Air can be passed through the car only by keeping the ice hatches open. Merely opening the ice hatches, however, does not best accomplish this result. At the same time cinders and dust are admitted, to the detriment of the lading. The problem has been to secure some mechanical device to attach to the ice hatches which would keep out cinders and dust and at the same time create a current of air through the car by the motion of the train. A number of such devices have come into use and some of them (1) are giving excellent results.

False flooring makes it possible to cool the contents of a car more quickly by allowing the cold air, coming into the main body of the car from the ice tanks, to penetrate beneath the entire load.

Many types of ice bunkers are in use, and there is probably a wider divergence (9) in the construction of ice bunkers than in any other part of the car. The efficiency of the different types will vary with the commodity, depending upon whether mild, medium, or sharp refrigeration is required. Further improvements will be needed as the volume capacity of cars is increased and as minimum weights are raised.

"The most vulnerable part of a refrigerator car," says the Railway Age Gazette, "is the insulation. Unless it is applied correctly and substantially, it is very apt to break away after the car has been in service awhile, which, of course, greatly decreases the efficiency of the car. There are several kinds of insulation that have been used, including cork, hair, flax fiber, and wool felt. While cork has the best insulating qualities, it has been found difficult properly to maintain a car insulated with it. Hair and flax fiber are more generally used, as they withstand better the weaving and torsional strains to which a car is subjected."

Wool and hair felt are good so long as they are kept dry. It is practically impossible to keep moisture from penetrating the insulation of a car. "These materials, when once moist, seldom dry out, and the result is putrefaction, giving rise to offensive odors which contaminate the goods in the car." (9)



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It is interesting to note in this connection that the regulations (2) promulgated by the American Railway Perishable Freight Association forbid the loading into refrigerator cars of a great many commodities. The list includes not only such articles as will leave an odor to contaminate perishable products, but also such as from their nature will be liable to injure the walls and insulation of the cars.

The construction of a sufficiently tight door for refrigerator cars has presented many difficulties. The lowest temperatures in the car in cold weather and the highest temperatures in warm weather are invariably found between the doors. When cars are under ice, the high temperatures here are attributable not only to the leakage of warm air from the outside through the joints of the door but also to the fact that this portion of the car is farthest removed from the ice bunkers.

What is needed more than anything else are reliable data on the efficiency of refrigerator cars of different kinds. Laboratory tests alone would be practically worthless. Tests must be made with commercial shipments under actual everyday operating conditions. The railroads and steamship companies themselves, so far as is known, have done little along this line beyond cooperation with outside agencies. It is a matter in which the transportation companies and the public are both vitally interested.

The department of agriculture of Canada (11) since 1900 has used recording thermometers in the cold-storage compartments of steamships transporting Canadian dairy and other perishable products to England. The records obtained have made it possible to secure the cooperation of the steamship companies in effecting many improvements in the transportation of these commodities under refrigeration. They have not been used, however, to compare the efficiency of different types of refrigerated compartments.

Mr. G. Harold Powell, at that time pomologist in charge of fruit transportation and storage investigations in the Bureau of Plant Industry, United States Department of Agriculture, and his assistants did some work of this kind in 1906 and 1907 with reference to refrigerator cars in the transportation of citrus fruits (12) from California. Other work of the same kind has since been done with other vegetable products. Dr. M. E. Pennington, chief of the Food Research Laboratory, Bureau of Chemistry, United States Department of Agriculture, and her assistants have done similar work with regard to refrigerator cars in the transportation of dressed poultry (9).

From the experiments made, Dr. Pennington's conclusions are "that most of the refrigerated carriers of the United States are not able to maintain sufficiently low temperatures during warm weather to transport a low-temperature commodity, such as dressed poultry, under the best of conditions."

It is admitted that the data of this kind so far secured are only a small beginning. The solution of the problem of insulating refrigerator cars must await more extended and more exhaustive investigations of and experiments in refrigerator-car efficiency. What must be determined is the efficiency of cars of—

1. The same age but different kinds of insulation.
2. The same age but different quantities of the same kind of insulation.
3. The same kind and quantity of insulation but different ages.

When these factors are combined with such variable factors as different types and sizes of cars, different seasons of the year, different commodities and quantities loaded in the car, and different climatic conditions, and when it is realized that a single combination should be tried many times before general conclusions approximating accuracy can be drawn, the time and expense in-

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volved, to say nothing of the difficulties that will be encountered, seem somewhat disheartening.

*Mechanical refrigeration.*—In a series of articles contributed to the Railroad Gazette and the Railway Age Gazette during 1907, 1908, and 1909 (14, 15, 16, 17, 18, 19, 20), Prof. Joseph H. Hart, of the University of Pennsylvania, discusses the refrigeration of perishable commodities as related to transportation, confining himself for the most part to mechanical refrigeration. He makes the following statement at the outset (14):

It can be stated that the refrigeration of cars by unit refrigerating machines, installed in the cars and operated either by the motion of the car itself or by power received from the engine, is impracticable, not only from a first-cost point of view, but also on account of its very small efficiency.

In discussing the possibilities of refrigeration by the use of brine he says:

The possibility of having single-tank cars carrying nothing but cold brine connected with pipes through the various cars and operated from the locomotive, very much as the modern air-brake system is utilized, presents a possibility which from an efficiency point of view is far superior to the methods now in vogue. * * * There is no doubt that it will be developed as soon as capable engineering experts take charge of the problem, although such men must be capable not only from a refrigerating standpoint but from a railroad standpoint as well.

Further consideration of the subject leads Prof. Hart to the conclusion that the lack of interest in mechanical refrigerator cars shown by the railroads is due both to the "peculiarly advantageous position of ice" (17) and also to the "unreliability and inefficiency of the mechanical refrigerator car as at present constructed" (18). The "advantageous position of ice" is well expressed, when one considers Prof. Hart's further statement that it can be manufactured in large quantities for 50 cents per ton (15). Natural ice is sometimes even more economical. It has been harvested for as low as 20 cents per ton. This figure, of course, does not include the cost of transportation to distant storage houses nor the loss from melting.

Much refrigeration energy goes to waste in the loss of the brine where salt is used with ice to secure lower temperatures. Attempts have been made to devise some appliance for catching and holding the brine and so distributing it around the body of the car as to continue the action of refrigeration (9). So far as the author is aware, the greatest success in this direction has been attained by the Pennsylvania Railroad Co. In the latter part of 1913 they put into service 36 all-steel milk cars, each 60 feet in length, for use in transporting milk by passenger train from western New York and Pennsylvania to Philadelphia and New York City. At each end of the cars are located six brine tanks, in which ice and salt are used. The insulated compartments at each end of the car communicate with a vestibule running crosswise the center of the car, so that the efficiency of the refrigeration is not counteracted at every opening of the side doors. The cost of these cars is in excess of $7,000 each, and the cost of operating them is likewise high. These two factors will militate against their general adoption and use.

Prof. Hart's apparent discouragement over the outlook for mechanical refrigeration in transportation is in contrast with the view of Dr. Pennington, who says (9):

Looking into the future through the glasses of the present, one sees trains of classified freight supplied with refrigeration from a portable mechanical source.

*Precooling.*—It would appear that the introduction of precooling also has diverted the attention of railway managers from the subject of mechanical re-

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frigeration. The development of precooling, however, has not eliminated the necessity for the mechanical refrigerator car.

So far as is known, the first precooling done in the United States was by Mr. G. Harold Powell (22), in 1904, while studying the causes of decay in peaches during transit from the Southeastern States to northern markets. Primarily "the object of precooling is to reduce the temperature of the fruit as quickly as possible to a point where ripening will be retarded and decay and deterioration prevented" (22). From this point of view, then, precooling in the beginning was not an essential element of transportation. The shippers provided it themselves with their own facilities and before the commodities had been placed in the refrigerator car. However, inasmuch as, prior to the advent of precooling, the reduction of the temperature of a perishable commodity started to market was begun by the carriers in refrigerator cars as an essential element of the transportation service, it was but a logical and short step for the carriers to provide facilities for the rapid cooling of entire carloads of perishable commodities, after they had been placed in the car, and to regard that as an essential element of the transportation service. (Strictly speaking, this is not precooling, but the original designation has become fixed.) In some cases, shipments so cooled were forwarded to destination without any ice being placed in the bunkers. In hot weather, where the distances were great and the time in transit long, the initial cooling was not sufficient, of course. Then came the idea that the initial cooling, while not eliminating the necessity for ice, would make possible great economies in the use of ice in transit. However, in a complaint (25) made to the Interstate Commerce Commission in 1909, it was testified by the carriers that, in the refrigeration of citrus fruit in transit from California to destinations, 2,000 and 3,000 miles distant, precooling as then practiced saved only from 1 to 2 tons (26) of ice. The normal amount used was 10 to 15 tons.

In the decisions (27) of the Interstate Commerce Commission in this case will be found an interesting and exhaustive history of precooling, with a clear statement of the relative rights and duties of shippers and carriers. Precooling is there viewed not as a service that must be performed by the carriers, under the requirements of the law,[1] and which can not be performed by the shipper, not yet as a service which the carrier may not undertake. Either the carrier or the shipper may perform the service. The affirmation of this view of the Commission by the Supeme Court of the United States[2] has been of great advantage to shippers of perishable products.

There are only four precooling plants in the United States which are operated by railroads. The tendency has been, and doubtless will continue to be, for the shipper to perform the service of precooling. A discussion of the different methods employed and their comparative efficiency belongs to refrigeration rather than to transportation. It is safe to say, however, that many exaggerated claims have been made as to the rapidity with which entire carloads of perishable commodities have been cooled to the requisite low temperature. Too many of the claims have been based on the temperature of the atmosphere of the car instead of the temperature of the commodity itself.

Where commodities are precooled in carload lots after being loaded into the car, and 24 hours or more are required for the operation, against the economy thus effected must be charged the expense of delay to equipment—a very considerable item in the aggregate.

Those who are interested in the technical details of construction and operation of precooling plants by the railroads will find excellent material in a

[1] See par. 2, sec. 1, act to regulate commerce.
[2] See 232 U. S., 199.

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paper (29) read at the joint convention of the American Society of Refrigeration Engineers and the American Association of Refrigeration, held at San Francisco in September, 1915, by Mr. C. M. Gay, of Los Angeles, in which he describes the precooling plant of the Santa Fe System at San Bernardino, Cal. A description of the two plants of the Pacific Fruit Express Co., one at Colton, Cal., and the other at Roseville, Cal., will be found in the Railway Age Gazette of March 18, 1910( 30, 31).

In considering refrigeration in transit, one must not lose sight of the credit due refrigeration engineers. This paper is concerned primarily with transportation. Refrigeration engineers, of course, will give first place to refrigeration. Refrigeration or transportation, either one alone, can accomplish little in a wide distribution of perishable products. Both together can accomplish much.

*Auxiliary service.*—As was said in the beginning, in discussing the transportation of perishable products, account must be taken of some things having, primarily, little connection with transportation. This is especially true of refrigeration in transit. Much has been done, and much still remains to be done, in the matter of mechanical appliances and the construction of icing platforms to minimize delay to trains at icing stations. The normal procedure is for a switch engine to cut out the cars to be iced and take them to an ice house. The distance to the ice house and the number of switches en route contribute to delay. In addition, if the icing is done at an inspection point, the car inspectors and the icing crew can not work at the same time.

In some sections of the West, where the construction of ice houses at freight division points has preceded population, it has been possible to have the icing platform and the icing track in the main yard. Cars can thus be iced and engines changed at the same time that car inspectors are going over the train.

One of the roads serving Denison, Tex., has experimented at that point with a specially constructed car to use in reicing trains in transit. The car has an opening in the roof and mechanism for readily elevating blocks of ice to the roof. On the arrival of a train to be reiced, a switch engine moves the car along an adjacent track. The ice is hoisted and transferred from the roof of the ice car as from an icing platform. It is doubtful if the saving effected offsets the expense of the additional handling of the ice.

Many existing storage ice houses were built in the early days of car refrigeration, when the importance of good insulation was not fully appreciated. As a result there have been great losses of ice by melting in storage. An example of improvement and greater efficiency in this respect is afforded by the reinforced, fireproof, concrete ice house, insulated with fine regranulated cork, built during the latter part of 1913 by the Northern Pacific Railway at Pasco, Wash. (32).

In the beginning railway managements were skeptical of the success of refrigerator cars. They would haul them at the entire risk of anyone who was foolish enough to build and use them, but the roads themselves could not afford to build or own them. Hence came the private car company and the anomaly of a carrier paying for the privilege of moving another's car over its roadway instead of charging for the service of furnishing the roadway. In the anomaly, now the normal, was recognized the duty of rail carriers to furnish vehicle as well as roadway.

The rise of the private car lines was accompanied by discriminations in car supply and abuses in refrigeration service until legislation was invoked to end a divided responsibility. With all responsibility placed on the carriers, the wisdom of building, owning, and controlling absolutely their refrigerator equipment became apparent. It is true that from the beginning some lines followed

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this course. The territory served by refrigerator cars of private ownership has become limited in comparison with its extent a decade ago.

Possibly the greatest improvement in the efficiency of our system of refrigeration in transit has come with the organization of separate bureaus or departments on individual systems of railroad, whose duties are restricted to the handling of refrigeration only. In some cases, as with the Great Northern, the Illinois Central (33), and the Frisco System, the cars are owned and operated directly by the railroad company and the employees of the refrigeration department are direct employees of the railroad company. In other cases, as on the Santa Fe, the Union Pacific, and the Southern Pacific systems, subsidiary companies have been organized in which is vested the ownership of the cars. All refrigeration matters are handled by these companies.

The refrigeration company makes frequent surveys of all producing sections which it serves and secures estimates of the prospective production of all commodities that will be handled in its cars. It looks after such matters as the purchase and building of new cars, the maintenance of its cars, car supply, ice supply, and reicing in transit. The relations between the refrigeration company and the railroad company are exceedingly close, and for all practical purposes the two may be regarded as one. However, whether the refrigeration service is handled by a separate bureau or department of the railroad or by a subsidiary company, it has been demonstrated that this method results in greater efficiency than when the service is handled by officials and employees charged with other duties also. It has been an advantage to both carriers and shippers and has developed improvements in the service of refrigeration in transit more rapidly than would otherwise have been possible.

At the present time the refrigeration service is conducted in this way on some seven or eight of the large railroad systems, which include about one-fifth of the entire mileage of the United States.

### PROTECTION AGAINST FREEZING.

Refrigeration is the process of keeping cold in and heat out. When the seasons are reversed it sometimes becomes necessary to keep heat in and cold out. The commodities requiring heat in winter are few in comparison with those requiring refrigeration in summer. Apples and potatoes are the principal ones. For 20 years potato shippers in the United States have sought a means of protection against freezing that would combine efficiency and economy. Considering the advanced stage of the art of refrigeration in transit, it is surprising that so little has been done in the line of heater service. Many of the methods still employed might be termed archaic.

The act to regulate commerce does not specifically lay upon carriers the obligation to provide protection against freezing in transit. As a consequence, tariffs covering this service, quite unlike those covering refrigeration, name one rate, when the responsibility for protection and the risks of freezing are assumed by the shipper, and a higher rate when the responsibility and risks are assumed by the carrier.

In the evolution of our transportation practices, things are now required of carriers that were once optional with them. Prior to 1850 in the United States, live stock was driven to market (34). For some time subsequent to that date a shipper would not have ordered stock cars from a railroad with any hope of getting them; nor would the question of forcing a railroad to furnish them have been seriously considered. There were no refrigerator cars prior to 1865, and the same thing was true of railroads furnishing that class of

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equipment. Today one orders cars of either of those two classes, confident of receiving them and with no thought of any question being raised as to the duty of carriers to furnish them.

That point has not yet been reached with regard to heater cars, but is rapidly being approached. On a complaint by New England potato shippers (35) the Interstate Commerce Commission in 1912 declined to express any opinion as to the obligation of carriers in general to furnish protection against cold. They were convinced, however, that there was no distinction in principle between the obligation to furnish refrigeration and the obligation to furnish heat. In 1913, in considering the transportation of potatoes in winter from points in Wisconsin and Minnesota (36–37), they were somewhat more inclined to the idea of carriers being required under the law to furnish heater service.

It would appear to be a simple enough matter to protect perishable products from extreme cold in transit by the construction of a car with the necessary amount of insulation. The very high initial cost of such a car, together with correspondingly higher maintenance and operating costs, makes its use impractical. As a result some means of generating heat within the car must be relied upon.

In New England there is in use for potato shipments an insulated car permanently equipped with heating apparatus built underneath. The fuel is kerosene oil, and the heat is conducted by pipes to the interior of the car. Even in New England not all potato shippers use this car. Many claim it is more economical to follow the practice prevailing elsewhere of using a portable heater and sending a man along to look after it.

Experiments have been made with different kinds of fuel and heaters (38). Alcohol (45), charcoal (39), coal, and oil have been tried. Whatever the fuel, any portable heater which necessitates the frequent opening of the car door is objectionable on that account alone. However, the portable heater continues to hold its own, in the absence of any other method combining equal efficiency and greater economy.

A storage system (40) of heating was devised some 10 years ago and given extensive trial (41) on the Chicago, Burlington & Quincy Railroad, which had about 100 cars equipped with the device. The heating mechanism consisted of an iron cylinder, containing corrugated terra cotta brick, placed in each ice bunker. Heat was secured by steam from the locomotive. Each car was equipped with a thermometer having the bulb on the inside and a registering plate on the outside.

Cars thus equipped were satisfactory in protecting perishable commodities from freezing, but certain operating conditions made it advisable to discontinue their use in heater service. To secure the best results in heater service it was necessary to assign them to certain runs on which, at division and set-out points, were located facilities for securing steam from roundhouses. Restricting their use in this way increased the road's empty-haul expense and made impossible interchange with other roads.

So far as is known no experiments have been made with electric heaters, with current generated by the axle of the car. Initial cost doubtless would condemn such a device at the present time even if it were theoretically efficient.

Any mechanism permanently attached to the car must be so located as not to take up cargo space nor to hinder speedy loading and unloading. Whatever system is adopted of securing heat from the locomotive or from the movement of the car, account must be taken of the more or less long periods when a car is standing in terminal yards awaiting transfer from one road to another.

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It seems altogether probable that some method of heating by steam (42) from the locomotive will be perfected. It would appear altogether feasible to use in the steam heating of refrigerator cars the same thermostatic devices as are in use on passenger cars (43–44).

SPECIFIC COMMODITIES.

*Bananas.*—It may be of interest to call attention to the special requirements of certain commodities. Bananas have been imported into the United States since 1872 (1). They are most palatable if subjected to a ripening process after the bunches are cut from the plant. Their extreme sensitiveness to even moderate changes in temperature make the utmost care necessary in handling them. They are distributed by rail from different ports to all parts of the United States and Canada, and have come to be an important part of the food of the people. The greater part of the business is in the hands of one company, which controls every feature from production on its own plantations to placing the fruit in the hands of the consumer. Its own steamships are specially constructed for maintaining proper temperatures, and its own attendants accompany every car from port to destination. This is a special industry where little has been left to the rail carriers in originating improved methods of service, but the enormous increase thus brought about in the consumption of bananas in the United States indicates the possibilities with other products.

Another company has come into the field using steamships with specially constructed holds for the importation of bananas from Hawaii (46).

*Fish.*—Unlike fresh meats, fish are best preserved by being packed in ice (1). Shelled oysters, on the other hand, lose flavor by coming in contact with ice and are best transported in sealed cans, around which the ice is packed. The transportation of fish and oysters in the United States is accomplished almost entirely by express, and so efficient are the methods of preservation in transit that Atlantic coast cities regularly receive car-lot shipments of fish from the Pacific northwest, a distance of more than 3,000 miles.

*Milk.*—In some of the continental countries of Europe milk has been frozen in blocks and transported in that form (1). Condensed or evaporated milk, canned, as well as powdered milk, has served as a substitute for fresh milk in sections remote from dairy herds. Improved transportation methods now make it possible for even the poorest in our large cities to have fresh milk daily. As cities have grown larger and as the suburban sections formerly given over to dairying and truck gardening have receded, it has become more and more impossible for the people to be supplied with fresh milk brought in by wagon. To-day New York and Boston are receiving milk from sections as far as 300 and 400 miles distant. In 1905 three of the principal carriers serving New York City (53) agreed to carry milk to that point in refrigerator cars.

At the present time many solid milk trains are run to New York daily. The cars of these trains are built and equipped similarly to baggage and express cars, for handling in passenger trains at high speeds, and the trains are run on passenger schedules.

The metropolitan district of Boston receives about 60 carloads of milk daily (47), practically all of it arriving under refrigeration when the weather is warm enough to require it. Some is handled by the express companies in their regular service, which includes pick-up and delivery by wagon. Some is handled by the express companies at a lower rate, conditioned on no pick-up or delivery service. Some is handled by the railroad companies in baggage-car service. Some carloads arrive in passenger trains in milk cars, and much of it arrives in insulated box cars in freight trains. The baggage car and express

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shipments are not refrigerated, making necessary the use of cans jacketed to maintain low temperatures secured before the milk is put on the train.

Rapid increase in the population of other cities raises the question of adequate milk supply, and improved service and facilities for the transportation of this commodity are increasingly in demand. One of the most important things is the question of refrigeration for small shipments. The system of rates prevailing in New England is not all that could be desired (48), and more reasonable rates are needed in some sections. Reference has been made to the improved cars of the Pennsylvania Railroad. Taking the traffic as a whole, throughout the country, probably the thing most urgently needed, next to adequate loading facilities, is a car affording efficient refrigeration for the pick-up service of a local run.

*Live poultry.*—For many years the transportation of live poultry in the United States was confined to less than car-lot shipments in portable coops by express. At the present time, large cities, particularly New York, receive from distances of 1,000 and 2,000 miles, almost daily, many carload shipments by freight service in specially constructed live poultry cars. Few, if any, of the railroads own any equipment of this kind. It is practically all owned by two private companies (13) with whom shippers must contract for the use of the cars.

They are constructed with tiers of coops on each side of a central aisle. In some cases the coops are removable, in other cases they are permanently built into the cars. Provision is made for the transportation of feed and water, with an attendant in charge. The sides of the coops are of wire netting, and no method has yet been devised for adequately protecting the fowls in extremely cold and inclement weather.

*Live stock.*—The prevailing type of vehicle used for the transportation of meat animals is the ordinary slatted car. Some are permanently double-decked for the more economical carriage of sheep, goats, and hogs. Practically all of them may be double-decked, if necessary.

Many of the cars used in the United States are owned by private car companies (13). The number of those owned by railroad companies increased 36 per cent (5, 6) between 1902 and 1913. Their capacity increased from an average of 25 tons to an average of 31 tons. In 1902 stock cars comprised 3.7 per cent of the total number of cars owned by the railroads and in 1913, 3.4 per cent. Many of them are now built with a weight carrying capacity of 80,000 and 90,000 pounds. This indicates not the weight of animals actually put into them, but rather the fact of steel underframes and strength to withstand the hard usage of heavy trains drawn by powerful locomotives.

Some cars are still equipped with watering troughs and facilities for feeding in transit. The necessity for this equipment was largely eliminated by the passage in 1873 of a Federal law requiring animals to be unloaded for feed, rest, and water at least once every 28 hours. (The law was amended in 1906 extending the time to 36 hours at the option of the shipper.)

The time required to load and unload live stock is an important element in the cost of transportation (34). On some roads certain days are designated for the handling of live stock. "Empties" are distributed over a division one day and on the following day the loaded cars are picked up. As many, if not most, stock-loading stations have pens with only one chute, much time is consumed by the locomotive having to "spot" the cars, one after another, at the chute. If the cars could all be loaded and ready on the arrival of the train, much time and expense would be saved. With this end in view, a Texas man (49) in 1904 devised a stock car with end doors and platforms adjust-

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able over the couplers. The idea was to "spot" one car at the chute and drive the animals through the cars. No information is at hand throwing light on the practical objection that prevented the general adoption of this car.

The Government lines of Argentina have a stock car with end doors, which is commended by an American observer (66) as being superior to the cars in use in the United States in the matter of loading and unloading.

In some sections of the country live-stock rates are still made on a per-car basis, the rate varying with the length of the car. It would be more logical to put all such rates on a weight basis, which would remove the temptation for shippers to overcrowd animals in an effort to economize in freight charges. Even when rates are provided on a weight basis, the tendency is to overcrowd animals in order to avoid fractional car lots, which must pay the minimum carload weight. Overcrowding results in deterioration and loss of animals and is a most prolific source of claims against the carriers.

Among contrivances for the comfort and care of animals in transit attention is called to a device of the Frisco Railroad for spraying (5) hogs in cars with cool water to prevent their dying of heat.

Some roads lease their stock pens to private companies that sell feed and furnish assistance in loading and unloading and caring for animals. There is much complaint in some sections of exorbitant prices of feed, brutality to animals, lack of water, and insanitary pens under this system.

### EXPRESS COMPANIES.

What has been said of railroads applies, for the most part, to the express companies as well. They provide a service similar in every respect, but with greater speed as the principal element. In addition, they collect packages from the homes and business places of their patrons and at destination deliver them to such places. They do both a carload and a less-than-carload business. So far as is known, only one of the express companies of the United States has any refrigerator cars of its own. This company has recently added to its refrigerator equipment (51) 35 cars with steel underframes, 50 feet in length, of a weight capacity of 60,000 pounds, and with a bunker capacity of 14,000 pounds of ice. The other companies secure their refrigerator equipment from some one of the roads over which they operate.

In the territory served by one of the large express companies, no carload express service with refrigeration is available. This is apparently due to two causes. The territory in question is comparatively close to the largest markets of the country and most commodities under refrigeration will reach those markets by freight train without deterioration. In addition, any rate low enough to secure the business by express would have to be so low that the railroad company's share of it would be less than the freight rate. The increasing production of commodities more highly perishable and the exigencies of changed market conditions strongly indicate a need for express refrigerator service in this section. A sense of both duty and good business demands that the railroads having contracts with the express company in question no longer stand in the way of such service.

### ELECTRIC LINES.

Electric traction came as a substitute for the horse, and electric lines were confined at first solely to the handling of passengers. They are now invading the field of freight traffic and some of the older steam roads are electrifying portions of their lines. In some cases the handling of freight was virtually

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forced on the electric roads in developing passenger business (53). In other cases they undertook it voluntarily for additional revenue.

The electrically operated interurban lines of the United States are furnishing a most valuable service in the transportation of fruit, vegetables, and milk from near-by producing sections to large cities. The train unit being a single car, frequent service with many stops is practicable. Farmers are able to send their produce to market without the long wagon hauls so generally necessary to reach stations of steam roads.

The chief problems yet to be solved are satisfactory terminals near the principal city market and the running of freight cars through the streets so as to avoid interference with the handling of passengers.

Electric traction would be no obstacle to the steam heating of perishable products in winter. Steam roads that have electrified their New York terminals have solved the problem of steam heat for passenger cars by the use of an electric steam boiler.

The use of electricity might be more desirable from the standpoint of mechanical refrigeration.

### WATER CARRIERS.

In considering transportation by water, attention necessarily must be given to transoceanic service as well as to coastwise and inland boat service. Only a comparatively few perishable products are handled in transoceanic service, such as fresh meats, citrus fruits, apples, and butter. As it is possible on shipboard to secure efficient mechanical refrigeration, the questions of most importance are rates, port facilities, and availability of space on direct sailings.

United States butter for Hongkong has to be forwarded by Australia and transshipped at Sydney (54). Canadian apples for Buenos Aires have to be forwarded by British ports and transshipped there (11). The greatest tonnage involved is undoubtedly that of frozen and chilled beef from New Zealand, Australia (55), and the Argentine (56) and there is apparently no shortage of refrigerator space for this class of traffic.

Mr. David Lubin, delegate from the United States to the International Institute of Agriculture, at Rome, has called frequent attention to the question of ocean freight rates and the necessity for effective governmental control of both rates and service.

Port facilities for the proper transfer of cargo between cars and vessels include tracks, wharves, warehouses, and mechanical appliances for handling packages (57). In the transportation of perishable products the first essential is to get them from refrigerator cars into the refrigerated compartments of vessels and vice versa in the shortest possible space of time.

An interesting case has developed in recent years on the Great Lakes. Two routes were available for the movement of dairy products to Atlantic seaboard cities from the States of Wisconsin and Minnesota. Rates by the all-rail route were higher than by the rail-lake-and-rail route, but lack of refrigerated space on the railroad-controlled steamers between Duluth and Buffalo made the latter route impossible. Appeal to the Interstate Commerce Commission was necessary (58) to secure refrigeration. The commission has since required (59) the railroads involved to relinquish control of the boat lines. Sufficient time has not yet elapsed to determine what facilities will be available in the future.

On the eastern coast of the United States there has been a considerable movement of perishable commodities by coastwise steamers from Jacksonville, Savannah, Charleston, and Norfolk to Baltimore, Philadelphia, and New York.

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For the most part refrigeration has not been necessary, but improved facilities would undoubtedly increase the traffic.

On the Chesapeake Bay and around Norfolk, Va., every variety and size of craft is available for the transportation of perishable farm products (60). In some cases it is transported to market and in other cases it is thus assembled for forwarding on ocean-going steamships or in carload lots by rail. Similar traffic exists at numerous other coast points.

The National Association of Railway Commissioners has had occasion frequently to call attention to the necessity for reviving transportation on the rivers of the United States (67). The possibility of water transportation has been a most potent factor in the reasonableness of freight rates by rail. It may be noted here that the State of Alabama controls water carriers within its borders as effectively as it controls rail carriers. To one who has given exclusive attention to rail transportation the volume of perishable products handled on the rivers of the United States will come as a surprising revelation (60). A close observer attributes the decline of traffic (61) on the Mississippi River to the failure for the last hundred years to improve terminal facilities, methods of handling cargo, and the type of boat. Undoubtedly similar conditions exist on other streams. If this is true of ordinary freight, how much more essential is it that such defects be remedied in order that adequate transportation facilities be had for perishable foodstuffs?

## UNIFORM GAUGE.

Returning to rail carriers, it will be well to consider some features of track and motive power susceptible of improvement in the handling of perishable products. Questions of rates, long established practices, and miscellaneous services also will be dealt with as they afford help or hindrance to a wider and more efficient distribution of perishable foodstuffs.

The gauge of a railroad is sometimes determined by the topography of the country traversed and sometimes by the desire to build it as cheaply as possible.

In the beginning, in the United States, lines were short and detached and had only a local traffic. As they were extended and connected, the economy of forwarding shipments to destination without transfer from one car to another en route made the need of a uniform gauge very apparent. This need was greatly augmented as the tonnage of perishable commodities increased. Transfers of "dead freight" merely brought delay and an increased cost of doing business. Transfer of products under ice or heat might result in the loss of the entire shipment.

A uniform gauge of 4 feet 8½ inches was adopted by the railroads of the United States in 1886 (62) as the "standard gauge." At the present time only one road of more than average importance has any considerable narrow-gauge mileage. Of 2,600 miles on this line, approximately one-fourth has a gauge of 3 feet. In spite of the extremely mountainous character of the country traversed, plans are being made to change this to standard gauge. The increasing production of fruit, which must be moved under refrigeration, in the section served by this line is an important factor in the proposed change of gauge.

The question of diversity of gauge is coming to the front in Central America. In Australia, where there are four different gauges, 4 feet 8½ inches was decided upon as the standard gauge in 1913, after more than 60 years of discussion (62).

As the great plains of Russia are populated and developed, undoubtedly the central States of Europe will draw foodstuffs from that section. The

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central States have, for the most part, a gauge of 4 feet 8½ inches, while the Russian gauge is 5 feet.

The prevailing gauge in India is 5½ feet, though there are other gauges in the country. In 1904, 50 per cent of the mileage of Africa was of 3½-foot gauge (63), and there were a half dozen or more other gauges. Much of the railway mileage of that country will be unconnected for many years, but it is significant that there is a diversity of gauge in adjoining areas controlled by the same power.

Argentina (64) has three gauges while Brazil has six (65). The meter gauge prevails in Brazil while the greater part of the mileage of Argentina is 5½ feet. In 1904 Brazil was planning the widening of some gauge, and in 1905 the Great Western Railway of that country was arranging to change some line from a gauge of 5 feet 3 inches to a gauge of one meter. In the same year of 1905, Argentina was planning the construction of some additional narrow-gauge mileage.

The fact that three-fourths of the railway mileage of the world is of the British standard gauge of 4 feet 8½ inches is no argument that the rest of the mileage should be changed to that gauge. Commerce can not be limited by international boundary lines, and each continent at least ought to adopt a uniform gauge for all of its railways. The countries of South America (66), while railway building there is yet in its infancy, have an excellent opportunity to avoid the costly experiment of a diversity of gauges.

### MORE POWERFUL LOCOMOTIVES.

From the standpoint of the shipper, the use of more powerful locomotives can hardly be regarded as an improvement in transportation service. There is good ground for believing that, in the handling of live stock and perishable, their use is a positive detriment (67) under certain operating practices prevailing in some sections of the United States. The practices referred to are the putting into a train of the maximum tonnage for which its locomotive is rated and the holding of trains at terminals till full tonnage is secured. The latter is not so common as the former, especially with live stock and perishable, but there are instances of it.

Giving locomotives their maximum tonnage does not depend, of course, on the size of the locomotive. It results, however, in slower time than live stock and perishable should make and leads to agitation for legislation limiting the length of trains. Some of the States of the Union provide a more equitable remedy by prescribing the speed at which these commodities shall move.

Slow movement of live stock and perishable results in many claims (sometimes involving expensive litigation) on account of the failure of consignments to reach the market when prices were more favorable. Anything tending to lighten the economic burden of the loss and damage claim bill now borne by the country is to be welcomed.

The long train, drawn by the modern, heavy locomotive, is subjected to unusual shocks in stopping and starting, and is more likely to break in two, which, with cars equipped with air brakes, causes even worse shocks. All this has been, and is, a fruitful source of live-stock claims.

The slow movement of live stock, with Federal legislation requiring animals to be unloaded at least every 36 hours for feed, rest, and water, involves additional expense to the shipper and further deterioration of the animals with every unloading.

The economy of full tonnage has been mathematically demonstrated in the handling of low-grade commodities on double-track lines of dense traffic.

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Single-track roads, with lighter traffic and a greater proportion of live stock and perishable, have more or less blindly followed the principle apparently without sufficient investigation (68).

### RATES.

The question of rates has been the one around which has centered most of the discussion of railways and the service performed by them. Every country has had its era of rate agitation, whether the railroads were privately or government owned. In some of them satisfactory adjustments have not yet been reached. Speaking for the United States, it has not been so much a question of the absolute rate charged as it has been a question of discrimination between persons and places. Probably we shall never reach that point when every shipper and every community is convinced that no betterment in the rate situation is either possible or desirable.

Under the system of class and commodity rates prevailing in the United States a situation arises at times disclosing the need of a more equitable adjustment for some commodities. Two examples come to mind. The peach crop of 1915 in some sections was above the average. Growers in West Virginia and Maryland desired to find markets in the South. No peaches had ever before been offered for movement in that direction, and, as a result, there were no commodity rates available. A depressed cotton market in 1914 led many cotton-producing States in 1915 to plant an unusually large acreage in grain. Hitherto they had bought grain from other sections and had satisfactory inbound rates. There had been no outbound movement of grain nor local movement within the section involved, consequently nothing but class rates were available. The need of the carriers for additional business, coupled with a desire to aid in the prosperity of their patrons, brought about a prompt adjustment of these two cases.

There are other cases which are not so easily adjusted. While the act to regulate commerce, through the powers conferred on the Interstate Commerce Commission, provides ample facilities for the adjudication of all such matters, some of the cases coming before that body are so complicated as to require a great deal of time for their determination.

So far as the transportation of perishable products (69) is concerned, speaking generally for the entire country, there is little room for complaint in regard to rates (24). There are other features of transportation service where the need of improvement is more apparent—features over which the Interstate Commerce Commission's jurisdiction is not so extensive as in the matter of rates.

### GOVERNMENT OWNERSHIP AND OPERATION.

It may be remarked here that there are some difficulties experienced in the United States, through the conflicting interests of private operating companies, which would apparently be obviated by Government ownership and operation. There would be no incentive on the part of the Government to forward shipments by other than the most direct route. Circuitous routing even of perishable commodities is still too prevalent, nor is it all due to selfish motives of the carriers.

There would be avoided the economic waste involved in the vast mileage made by empty cars under the system of interchange agreed upon by American roads.

Any car on a road to which it does not belong is called a "foreign" car. The code of car service rules adopted by the American Railway Association

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and which governs the interchange of equipment, provides that foreign cars must be returned promptly to their owners, and in general for the return of empty foreign cars to the home, or owning, road by the same route over which they left the home road. Foreign cars must be utilized in preference to home cars for loading to other roads. If a foreign car can not be loaded to a point on its home road it must be loaded "in the direction of the home road."

Observance of the car-service rules in detail frequently makes it impossible for a shipper to get cars promptly. It is often a decidedly troublesome question when shippers desire to divert in transit shipments of perishable commodities under refrigeration. It is necessary, under existing conditions, for a shipper to give the destination of his goods when ordering cars for their movement. Much of the fruit and vegetables of the United States is unsold and its destination unknown at the time it is loaded. Complications arising for these causes would be avoided by Government ownership and operation.

Another difficulty under private management is the unwillingness of steam roads to inaugurate through rates and through billing and to construct proper facilities for the interchange of traffic with interurban electric lines, especially where the latter are in competition with the steam roads.

Most of our larger cities are served by more than one railroad. A dealer or a market is located on the tracks of some one railroad, but receives shipments by all of them. The refusal of the one railroad directly serving the dealer or the market to switch cars arriving by other roads except at an exorbitant rate—or sometimes to switch them at all—has occasioned bitter controversies and expensive litigation.

None of the cities of the United States has yet become so large as to have more than one principal wholesale market for fruits and vegetables. The lack of a common terminal, however, to which all lines have access on an equality adds greatly to the expense, labor, and inconvenience of maintaining one principal market. A common terminal would mean the ability to route by any line. Some roads would thus lose the monopoly which they now enjoy of certain classes of business, and quite naturally they oppose the establishment of a common terminal.

It is true that our railway law provides in one form or another a remedy for all of the conditions just cited, but the practical application of the remedy is sometimes a slow and tedious process.

### DEMURRAGE.

Under existing regulations in the United States shippers have 48 hours in which to unload their consignments after arrival at destination. Beyond this period a demurrage charge of so much per car per day is assessed as a penalty for the detention of the car and to stimulate its prompt release. The two days of free time are of especial value to receivers of perishable commodities under refrigeration. They are provided free cold storage while negotiating sales or waiting for better prices.

Dealers in fruits and vegetables have opposed very generally every move to curtail the free time or to raise the demurrage rate. They have contended strongly for further extension of the free time and a lowering of the rate. The author is convinced that to grant their contention would relieve that particular business of an item of expense that in all justice it should bear (23), the corollary being that some other business must necessarily bear an undue proportion of transportation expense.

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Every privilege accorded shippers in holding cars beyond the time actually needed to load and unload them is of doubtful economic value. In the case of perishable commodities under refrigeration the provision of cold-storage warehouses at large terminals, making it possible to take care of such commodities immediately on arrival without holding cars, would be a less economic burden to the community at large.

### MISCELLANEOUS SERVICES.

There are many other things worthy of mention in discussing improved service for the transportation of perishable products. Only a few of them can be included here. Some of them only indirectly concern transportation. It has sometimes been difficult to draw the line between transportation and other activities relating to the general problem of distribution and marketing of foodstuffs.

*Determination of best variety of products.*—It sometimes happens that of several varieties of some commodity all are not equally hardy or capable of holding up under modern transportation. In the United States it has devolved upon the scientists of the State agricultural colleges and of the National Department of Agriculture to determine the variety most suitable.

*Preparation for transportation.*—After production, proper methods of handling and packing have had to be considered. In this field also the United States Department of Agriculture has led the way. Beginning with the work of Powell with the citrus fruits of California (70), investigations have been made and experiments conducted with many other fruits and vegetables. One would naturally infer that the work, as conducted by the Department of Agriculture, was primarily for the benefit of producers, to enable them to put salable products on the market. Such, however, was not the case. It was kept in mind that the consumer also would benefit by lower prices resulting from greater volume. The interest of the carriers, too, was not neglected, and this auxiliary service, costing them nothing, increased their tonnage and their revenue and at the same time decreased their loss and damage claim payments, all of which contribute directly to better service.

*Uniformity of packages and estimated weights.*—Packages must necessarily be strong enough to withstand ordinary handling without loss of or damage to contents. The increasing cost of lumber and the desire to economize in freight charges militates against a sufficiently strong package. Responsibility for the economic waste of freight claims on this account rests more largely with shippers than with carriers.

Standardization of packages can not be too strongly indorsed nor too speedily enforced by legislation. Uniformity of shape and weight will logically follow uniformity of volume. Uniformity of shape will promote speedier and better loading into cars. Uniformity of weight will make possible more extensive tariff publication of estimated weights, with consequent saving of the time and labor now spent in weighing shipments and in handling claims for overcharge in weight.

*Use of mechanical conveyors.*—Mechanical conveyors and similar appliances for handling freight probably are used less by rail carriers than by water carriers. They have practically no place in the rail transportation of perishable products. One central produce terminal for each large city, accessible to all railroads serving the city, provided with cold storage and other warehouses, in addition to its great benefits in other ways, would make the use of mechanical appliances for handling freight both possible and desirable. Thus would be eliminated the insanitary and expensive team-track methods now in vogue everywhere.

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*Standardization and pooling of cars.*—A further standardization of cars would contribute directly to better car supply and greater car efficiency (71).

Some of the benefits accruing under Government ownership and operation would result from a pooling of cars also. There would be no empty haul merely to get a car back to the owning road. Cars would move only under load or to secure a load. They could move in any direction and by any route. Shippers would not see empty cars on hand at their stations and find themselves unable to use them because the destination of their goods and that of the car did not happen to be the same. Cars were made for traffic and not traffic for cars.

*Improvement of terminals.*—The railroad terminal has been pronounced more than once by the ablest railroad officials in the country as "the weakest feature in the whole structure of American railroads" (71). The slightest congestion of freight reveals this weakness, and on no class of traffic do its deficiencies fall more heavily than on perishable products.

*Transit privileges.*—Reconsignment and diversion privileges, so generally accorded under American freight tariffs have been of inestimable value to shippers of perishable commodities, though instances are not lacking of the abuse of these privileges by shippers. Other transit privileges, with protection of the through rate, such as stopping to partially load or unload, concentration, grading, and storage are to be neither approved nor condemned on general principles. They offer many advantageous possibilities, but they should not be granted on perishable products at the expense of other commodities.

*Cargo inspection.*—The Canadian Department of Agriculture, in the work of its Dairy and Cold Storage Division (11), has an excellent system of cargo inspection that might well be adopted elsewhere. In addition to inspectors of refrigerator-car service at different points throughout the Provinces inspectors are maintained at the leading ports from which Canadian products are shipped to England. Four inspectors are stationed at ports in Great Britain also and, in addition, one at Portland, Me., through which port much Canadian produce passes. These inspectors have no regulatory powers over the carriers. They observe methods of handling freight, note the efficiency of different kinds of packages, take care of the thermograph records of commodities forwarded under refrigeration, and study the needs of more and better facilities both on vessels and at wharves. Their relations with the carriers are cordial, and through their reports the Department of Agriculture works in cooperation with the carriers for improvement in every phase of the service.

*Work of neutral inspection bureaus.*—A somewhat similar activity is being developed in some sections of the United States by the railroads in the work of so-called "neutral inspection bureaus." Here, however, the inspectors not only examine the condition of perishable commodities after they are loaded into the car, but they even go into the fields and examine the products before they are harvested, and at the same time they observe carefully the methods of harvesting and packing. Primarily, this service has in mind the collection of defensive data against prospective claims. Incidentally, the moral effect on shippers of the presence of the inspectors is excellent. No agreement has yet been reached whereby the inspectors place on bills of lading notations that products are in such an overripe or deteriorated condition that they should not be shipped. Possibly this would be a good thing, as it would ultimately result in such products giving place on the market to sounder and more wholesome stuff.

*Railroad inspection.*—The inspectors in mind are not railroad employees, but are men experienced in the fruit and produce business. Under the American system of receipting for carload consignments on a "shipper's load and count"



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basis, the station agent in the past rarely saw or examined the contents of cars before they were forwarded. It is coming to be more and more the practice now, however, on many roads to have agents examine carload shipments of perishable commodities and to make notations on bills of lading as to their condition at the time of forwarding. Agents usually are not experts in such matters and do not recognize the limitations restraining the inspectors of the neutral bureaus. Consequently, they usually play safe and are inclined to put on bills of lading such notations as will protect both themselves and their company, to the disadvantage of shippers.

To counteract the bad impression thus created, and at the same time to afford local agents some relief during heavy shipping seasons, some roads send out general-office clerks as inspectors. The result is little, if any, improvement.

The railroads of the United States never have fully recognized the fact that giving a man a title does not endow him with the qualifications necessary to the performance of the duties embraced in the title.

*Use of iced pick-up cars.*—In some sections of the United States, where traffic is sufficiently dense, the railroads give what is known as an "iced pick-up service." Dairy products and other commodities requiring refrigeration are picked up in less-than-carload lots and transported to market or to concentration points in iced refrigerator cars. The less-than-carload rates include the refrigeration service also.

Some of the packing companies distribute consignments of meat products in a similar manner to dealers in small towns not large enough to take carload shipments.

### SPECIAL MARKET TRAINS.

From certain live-stock producing sections special trains are run on such days of the week as will put the animals into the principal live-stock centers on the best market days. The bulk of the Imperial Valley cantaloupe crop starts to market in special trains carrying nothing but cantaloupes. Oranges are moved out of southern California in the same way. Solid trains of milk daily supply New York with that commodity. From Mobile special banana trains are run to northern cities. From Potomac Yards, Va., during the summer trains carrying nothing but perishable commodities daily move north through Washington to supply New York and other cities with foodstuffs. These may be all termed "special market trains," but there is a different kind of special market train that is needed in many parts of the United States.

In that section lying north of the Potomac and east of the Mississippi River are many populous cities needing perishable foodstuffs and much agricultural land yielding a variety of fruits and vegetables. Many sections produce no one commodity in carload lots, and difference of season prevents shipments of mixed carloads. Electric line service is not available. Express rates are too high, since they contemplate a collection and delivery service which is not needed. Local freight train service would be dear at any cost, since perishable commodities usually will have perished before they can get to consumers through the congested terminals of the average large city. In addition to prohibitive rates by express, the speed required of passenger trains precludes stops of sufficient length for perishable products to be properly loaded.

What is needed is a "produce car" attached to the local passenger train or to the local milk train to pick up small consignments of fruit, vegetables, and other perishable products for the nearest market. The time of transit would be so short as to make refrigeration unnecessary. If the volume of business was sufficient to justify it, the milk train could be duplicated in the "produce

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train." This presupposes, of course, if not a produce terminal common to all roads, at least a produce yard or designated tracks where the shipments could be secured immediately on arrival, just as is now the case with milk. Shippers would bring their stuff to the train and load it into the car. Consignees would remove it, if not from the car, at least from the platform, immediately on arrival.

With uniform containers and estimated weights a simple system of accounting records could be devised by the use of tags, in duplicate or in triplicate, somewhat like the baggage check now in use.

This would be a more valuable service than any now offered shippers of these commodities by the railroad companies. Naturally it should take a higher rate than is paid for existing local freight-train service. Collection and delivery by the carrier being dispensed with, it should take a rate lower than existing express rates.

Since the express companies are creatures of the railroad companies, the oft-quoted immutability of express contracts presents no serious obstacle to the inauguration of such a service. Nor does its proposal involve any idea of putting the express companies out of business. The business in contemplation is one they have hitherto not enjoyed, and there would still be left them the transportation of packages requiring collection and delivery, a service for which they have shown a remarkable genius.

To what extent conditions in Europe and other densely populated sections of the world demand a service of this kind the author does not know. If such conditions do not already exist in those newer continents now being populated by European emigrants, undoubtedly they will appear in the course of time in the provisioning of such cities as Sydney, Johannesburg, Santiago, Rio de Janeiro, and Buenos Aires.

### INFLUENCES FOR IMPROVED SERVICE.

To a student of the history of the railroads of the United States no phase of their development is more interesting than the evolution of their organization. The small road managed by one man, who supervised every detail, has grown into the big system embracing thousands of miles. Many separate departments have taken the place of the one man, each with its own organization and multitudinous duties.

The traffic department once kept in touch with the people and undertook to supply the service they wanted after an intelligent study and understanding of just what was needed. Other departments came to concern themselves wholly with moving passengers and freight.

Many things have caused the traffic man to depart from the performance of his normal functions. When not busy as an economist, justifying what he did yesterday or what he wants to do to-morrow, he has time to consider only the commodities that loom largest on the tonnage statement. As a result, it is safe to say that the traffic department of to-day has less acquaintance with the farmers of the country than with any other class of its patrons. It probably knows less about the needs of perishable products than about any other class of freight and is less prepared to suggest improvements in its transportation.

There are too few traffic officials and too much centralization of authority. The greatest improvements in the transportation of perishable products yet to come will be hastened by a change of methods in this respect.

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RÉSUMÉ.

A greater variety of food, extending through all seasons of the year, is a notable feature of present-day living conditions as distinguished from conditions of even 50 years ago. Improved transportation service has brought this about. No modern city can hope to maintain its industrial and commercial supremacy without adequate transportation facilities for securing steady and continuous supplies of perishable foodstuffs.

The most important factor in the transportation of perishable products has been the refrigerator car and the refrigerated compartment of steamships. Steamship refrigeration, confined so largely to transoceanic vessels, is of relatively less importance than railroad refrigeration by reason both of the fewer commodities handled under refrigeration by steamships and of the greater aggregate tonnage of refrigerated commodities handled by the railroads.

Experiments in mechanical refrigeration thus far have not developed a system which is either practical, economical, or efficient. Precooling has turned attention from mechanical refrigeration but has not eliminated the necessity for it.

Improvements in refrigeration, as related to rail transportation, must include mechanical appliances for handling ice, as well as better ice-storage houses and proper construction and location of icing platforms. An independent bureau or department to handle all matters pertaining to refrigeration results in better service than when such matters are handled by employees charged with other duties also.

The application of heat to protect perishable commodities from freezing in winter is the same in principle as refrigeration service. It is recognized that heater service also is a duty of the carrier, but much less has been done in developing an efficient service of this kind than has been done in refrigeration.

Fish, milk, live poultry, and live stock each requires a type of vehicle and other facilities different from those required by fruits and vegetables.

Express companies, electric railways, and boats all furnish a valuable service supplementary of, and in addition to, the service given by the steam railroads.

Uniformity of gauge is the first essential in successful long-distance transportation of perishable products under refrigeration. More powerful locomotives are a detriment under the "full tonnage" practices of some lines.

Rates in general are reasonable and must necessarily be so. Demurrage regulations may help or hinder efficient transportation, depending on their requirements and how they are enforced.

Government ownership and operation would obviate some of the difficulties now experienced under private ownership and operation. Some of the difficulties for which government ownership is recommended as a remedy would disappear with pooling of cars by private owners.

There are many miscellaneous services to be considered, some of which only indirectly concern transportation. Some of these services are: The determination of the variety of a given product that will best endure transportation, the preparation of shipments for transportation, uniformity of packages and use of estimated weights, use of apparatus for mechanical handling of packages, improvement of railroad terminals, granting of transit privileges, and the use of iced pick-up cars.

There are many so-called special market trains, but none which offers for fruits, vegetables, and dairy products the same service as is given milk by the milk trains.

Cooperation with carriers of outside, impartial agencies in the inspection of perishable commodities, and different phases of the service rendered in their

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transportation is one of the most important factors in improving the service. A reform in the organization and methods of the traffic departments of the railroads would increase such cooperation and make it more effective.

BIBLIOGRAPHY.

1. Culp, J. M.: Perishable Goods. Brussels, International Railway Congress Association, 1910.

2. American Railway Perishable Freight Association. Standard Rules and Regulations Governing the Handling of Perishable Freight, Circular No. 27–C. Chicago, 1913.

3. The Railroad Gazette. Vol. 40, No. 8, page 186. New York, February 23, 1906.

4. Armour, J. Ogden: The Packers, the Private Car Lines, and the People. Philadelphia, Henry Altemus Company, 1906.

5. Interstate Commerce Commission. Statistics of Railways in the United States, 1902. Washington, Government Printing Office, 1903.

6. Interstate Commerce Commission. Statistics of Railways in the United States, 1913. Washington, D. C., Government Printing Office, 1914.

7. Railway Age Gazette. Vol. 56, No. 5, page 215. New York, January 30, 1914.

8. Official Railway Guide, Quarterly Supplement. Vol. 4, No. 15, page 21, New York, July, 1915.

9. Pennington, M. E.: The Refrigeration of Dressed Poultry in Transit. U. S. Department of Agriculture Bulletin No. 17. Washington, Government Printing Office, 1913.

10. Railway Age Gazette. Vol. 56, No. 5, page 215. New York, January 30, 1914.

11. Canada Department of Agriculture. Dairy and Cold Storage Commissioner Annual Reports for the years ending March, 1913, and March, 1914. Ottowa, 1913, 1914.

12. Powell, G. Harold: The Decay of Oranges While in Transit from California. U. S. Department of Agriculture, Bureau of Plant Industry Bulletin 123. Washington, Government Printing Office, 1908.

13. The Official Railway Equipment Register. Vol. 31, No. 5. New York. October, 1915 (issued monthly and filed as a tariff publication with the Interstate Commerce Commission).

14. Hart, Joseph H.: Railroad Refrigeration. The Railroad Gazette, Vol. 42, No. 3, page 74. New York, January 18, 1907.

15. Hart, Joseph H.: The Present Status of Mechanical Refrigeration in Railroad Work. The Railroad Gazette, Vol. 43, No. 21, page 617. New York, November 22, 1907.

16. Hart, Joseph H.: Refrigeration in the Transportation of Fruit. The Railroad Gazette, Vol. 44, No. 19, page 629. New York, May 8, 1908.

17. Hart, Joseph H.: The Absorption Machine in Railroad Refrigeration. Railroad Age Gazette, Vol. 45, No. 9, page 624. New York, July 31, 1908.

18. Hart, Joseph H.: Precooling Plants in the South. Railroad Age Gazette, Vol. 45, No. 14, page 865. New York, September 4, 1908.

19. Hart, Joseph H.: Mechanical Refrigeration in Railway Transportation. Railroad Age Gazette, Vol. 46, No. 14, page 756. New York, April 2, 1909.

20. Hart, Joseph H.: Improvement in Refrigerator Cars. Railroad Age Gazette, Vol. 47, No. 6, page 237. New York, August 6, 1909.

21. The Railway Age. Vol. 45, No. 11, page 346. Chicago, March 13, 1908.

22. Stubenrauch, A. V.: The Precooling of Fruit. *In* United States Department of Agriculture Yearbook, 1910.

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23. White, G. C.: Demurrage Information for Farmers. U. S. Department of Agriculture Bulletin No. 191. Washington, Government Printing Office, 1915.

24. Weld, L. D. H.: Studies in the Marketing of Farm Products. University of Minnesota. Studies in the Social Sciences No. 4. Minneapolis, 1915.

25. United States Interstate Commerce Commission. Decisions. Vol. 19, page 148. Washington, Government Printing Office, 1910.

26. United States Interstate Commerce Commission. Decisions. Vol. 20, page 106 (119). Washington, Government Printing Office, 1911.

27. United States Interstate Commerce Commission. Decisions. Vol. 23, page 267. Washington, Government Printing Office, 1912.

28. Railway Age Gazette. Vol. 55, No. 13, page 567. New York, September 26, 1913.

29. Gay, C. M.: San Bernardino Precooling Plant. Ice and Refrigeration, Vol. 49, No. 4, page 177. Chicago, October, 1915.

30. Railway Age Gazette. Vol. 48, No. 11, page 725. New York, March 18, 1910.

31. Railway Age Gazette. Vol. 46, No. 26, page 1533. New York, June 25, 1909.

32. Railway Age Gazette. Vol. 56, No. 4, page 179. New York, January 23, 1914.

33. The Railway Age. Vol. 42, No. 3, page 87. Chicago, July 20, 1906.

34. Andrews, Frank: Cost and Methods of Transporting Meat Animals. *In* United States Department of Agriculture Yearbook, 1908.

35. United States Interstate Commerce Commission. Decisions. Vol. 25, page 159. Washington, Government Printing Office, 1912.

36. United States Interstate Commerce Commission. Decisions. Vol. 26, page 681. Washington, Government Printing Office, 1913.

37. United States Interstate Commerce Commission. Decisions. Vol. 29, page 505. Washington, Government Printing Office, 1914.

38. McPike, E. F.: Heating Cars Containing Perishable Freight. Railway Age Gazette, Vol. 51, No. 7, page 323. New York, August 18, 1911.

39. Railway Age Gazette. Vol. 54, No. 23, page 1230. New York, June 6, 1913.

40. The Railroad Gazette. Vol. 41, No. 13, page 275. New York, September 28, 1906.

41. The Railway Age. Vol. 40, No. 17, page 524. Chicago, October 27, 1905.

42. The Railway Age. Vol. 40, No. 16, page 478. Chicago, October 20, 1905.

43. Railway Age Gazette. Vol. 48, No. 3, page 169. New York, January 21, 1910.

44. Railway Age Gazette. Vol. 54, No. 241, page 1526. New York, June 19, 1913.

45. Railway Age Gazette. Vol. 55, No. 2, page 53. New York, July 11, 1913.

46. Shipping Illustrated. Vol. 53, No. 675, page 43. New York, October 9, 1915.

47. Boston Chamber of Commerce. Investigation and Analysis of the Production, Transportation, Inspection, and Distribution of Milk and Cream in New England. 1915.

48. United States Interstate Commerce Commission. Decisions. Vol. 22, page 303. Washington, Government Printing Office, 1912.

49. The Railroad Gazette. Vol. 36, No. 25, page 35. New York, June 17, 1904.

Digitized by Google

50. Railway Age Gazette. Vol. 58, No. 14, page 752. New York, April 2, 1915.

51. Wells Fargo Messenger. Vol. 4, No. 2, page 28. New York, October, 1915.

52. McMillan, J.: Businesslike Methods in Handling Freight by Electric Railroads. Electric Railway Journal, Vol. 46, No. 12 (Convention Section), page 482. New York, September 18, 1915.

53. The Railway Age. Vol. 39, No. 14, page 574. Chicago, April 7, 1905.

54. Ice and Refrigeration. Vol. 49, No. 4, page 208. Chicago, October, 1915.

55. Joss, E. C.: Meat Production in Australia and New Zealand. *In* United States Department of Agriculture Yearbook, 1914.

56. Melvin, A. D.: Meat Production in the Argentine and its Effect Upon the Industry in the United States. *In* United States Department of Agriculture Yearbook, 1914.

57. Andrews, Frank: Crop Export Movement and Port Facilities on the Atlantic and Gulf Coasts. U. S. Department of Agriculture, Bureau of Statistics Bulletin No. 38. Washington, Government Printing Office, 1905.

58. United States Interstate Commerce Commission. Decisions. Vol. 29, page 45. Washington, Government Printing Office, 1914.

59. United States Interstate Commerce Commission. Decisions. Vol. 33, page 699. Washington, Government Printing Office, 1915.

60. Andrews, Frank: Inland Boat Service: Freight Rates on Farm Products and Time of Transit on Inland Waterways in the United States. U. S. Department of Agriculture, Bulletin No. 74. Washington, Government Printing Office, 1914.

61. Marvin, George: Navigating the Mississippi. The World's Work, Vol. 30, No. 5, page 584. Garden City, New York, September, 1915.

62. Railway Age Gazette. Vol. 55, No. 2, page 40. New York, July 11, 1913.

63. The Railway Age. Vol. 38, No. 2, page 49. Chicago, July 8, 1904.

64. Lavis, F.: The Railways of the Argentine Republic. Railway Age Gazette, Vol. 56, No. 14, page 773. New York, April 3, 1914.

65. Railway Age Gazette. Vol. 47, No. 3, page 94. New York, July 16, 1909.

66. Lavis, F.: The Railways of the Argentine Republic. Railway Age Gazette, Vol. 56, No. 13, page 731. New York, March 27, 1914.

67. National Association of Railway Commissioners, Proceedings of the Twenty-sixth Annual Convention. New York, Law Reporting Company, 1914.

68. The Railway Age. Vol. 38, No. 10, page 302. Chicago, September 9, 1904.

69. United States Interstate Commerce Commission. Decisions. Vol. 35, page 623. Washington, Government Printing Office, 1915.

70. Powell, G. Harold: The Handling of Fruit for Transportation. *In* U. S. Department of Agriculture Yearbook, 1905.

71. Commerce and Finance. Vol. 4, No. 42, page 800. New York, October 20, 1915.

## CAR-LOT DISTRIBUTION.

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In the discussion of subsection 7, Section III, in the preliminary program of this congress, the following statement appears: "A phase of conservation of

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great importance is the reduction of waste in the marketing and distribution of agricultural products." Without doubt the makers of that program sounded the keynote. They graciously added: "The subject does not *necessarily* mean the elimination of the middleman in this process. Indeed, the middleman can well be regarded as a useful member of society." On behalf of 10,000 wholesale fruit and produce middlemen of the United States I tender profound thanks for this assurance.

To approach the subject of "Car-lot Distribution" intelligently, let us consider first the volume of fruit and produce grown in the United States that is distributed to the markets of the Unied States and the world, and the quantity of fruit and produce grown in Central and South American and in foreign countries that is distributed and consumed in the United States.

I will mention accurate figures as to three principal fruits—apples, bananas, oranges. The maximum production of apples in the United States annually approximates 60,000,000 barrels, or 400,000 carloads, with a wholesale value in the markets of about $150,000,000. The production in the United States of citrus fruits, principally oranges, aggregates 25,000,000 boxes, or 75,000 carloads, with a value of $60,000,000. The importations of bananas into the United States aggregate 50,000,000 bunches, or 125,000 carloads, with a value of $40,000,000. This is a total in these three fruits of 600,000 carloads per annum, with a total wholesale valuation in the markets of $250,000,000. In addition to this should be mentioned the huge quantities of peaches, berries, grapes, melons, potatoes, cabbages, onions, tomatoes, and a hundred other kinds of fruits and vegetables. In each of these products we have a large number of varieties, grades, and sizes, put up for market in various kinds of containers.

This picture may help us in a measure to comprehend the task performed in the distribution of such a gigantic mass of highly perishable food products. To complete the picture, consider only two people—the producer with an abundant harvest, who is anxiously scanning the horizon for customers, and, in the distant cities, the hungry consumer crying "Give us this day our daily" fruit and produce. Every factor between these two principals is simply the machinery of transportation and distribution. This machinery must be constructed and operated to perform the required service efficiently and economically to the satisfaction of both principals. There must be elimination of waste, as far as possible, because the very welfare and life of the people is dependent upon it.

The producer is the party of the first part. Upon him rests the heaviest burden of responsibility. Production must be brought to its highest state of perfection at the lowest cost. This involves practical knowledge of soil, climate, seed, cultivation, disease, irrigation, and fertilizers. The product must have character. From the very beginning the producer must keep before his vision his hungry brother, the distant consumer, whose wants he must satisfactorily supply if success is to be attained. Thousands of people are wasting their time, energy, and money in attempting production in soils, climates, and locations which can not give adequate returns. Naturally, such producers clamor the loudest and feel the most urgent need of improved distribution. Their ills, however, are internal, not external, and without remedy.

To the producers represented in and by this congress I bring the message: Conserve your energy and do not waste your time trying to devise some perfect method of marketing and distributing an imperfect product. Solve the problem of production first.

It is doubtful if any marketing machinery can be devised to distribute profitably to the consumer an inferior product. As a rule, when markets are

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normally supplied, only products of good quality, put up under standard packs and brands, are merchantable. Other grades frequently are almost given away.

The chancellor of one of our leading universities recently complained before the Pittsburgh Chamber of Commerce that he could find no buyer for his unsprayed apples on his country place near by. Said he: "The flavor is better than the finest northwestern fruit, although the appearance is against them." When I informed him and the chamber of commerce that his own wife and family would not eat this fruit, but were ordering box apples at $2 per bushel, he had nothing further to say.

Of even more importance than the successful marketing of any single season's crop is the matter of stabilizing this great fruit and produce industry, which is now classified as an "extra-hazardous business." The insurance business is a risky business, or, rather, a business of risks. The employment of the same intelligence and care can reduce this extra-hazardous fruit and produce industry to the perfected state of the insurance business of the present day.

What is needed most is thorough community and intercommunity organization, with the enforcement of rigid inspection and discipline, to the end that standardization, efficiency, and economy in all departments may be an accomplished fact. The producer suffers not so much from a lack of knowledge or facilities as from a failure to put into proper use what he now has.

I repeat, production is first. Following this, careful attention should be given to proper packing and packages, the importance of which few growers appreciate. Given a good merchantable product, the packer must classify varieties, grades, and sizes, and handle in conformity with established standards, each designated by attractive brands. This process must be so perfected that the absent customer may be able to order the exact quality, grade, size, and quantity desired with the same assurance of satisfaction as if he were personally present at the point of production to make his own examination and selection. Of the fruit and produce sold, consumers purchase, sight unseen, fully 75 per cent and retailers 50 per cent. Both retailer and consumer desire to purchase regularly the same variety and grade of any food product, whereas in the buying of fruit and produce it is difficult, as a rule, to duplicate purchases satisfactorily because of the lack of standardization. This is a decided handicap in distribution.

Packages must be designed to meet the requirements of convenient handling and transportation and, when possible, be suitable for the delivery of the product in the original package to the average consumer. Packing houses should be equipped for proper assembling and in some cases with dry and cold storage. Waste is reduced by eliminating, so far as possible, rehandling and incurring of unnecessary expense in packing packages and freight before the product is to be offered to the consumer.

Producers must be taught to do their work right in these two particulars. Fully 50 per cent of the labor, expense, and facilities connected with the distribution of perishable food in the markets of the country is made necessary in order to do what the producer has left undone or has done wrong. The distributer and dealer now must provide this equipment to prepare products for the consumer in at least a halfway acceptable form.

Proper distribution demands standardized packages, standardized packing, and the regulated synchronization of the movement of the product so that its transportation and delivery may be effected economically. Production and packing perfected, scientific distribution, involving transportation and salesmanship, may properly proceed.

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Successful car-lot distribution of a highly perishable product demands perfect equipment, quick schedules, equitable rates, reasonable classifications, privileges (storage in transit and others), and terminal facilities. In short, the transportation machinery must be adapted to the peculiar needs of this trade in highly perishable food.

Transportation and distribution of fruit and produce should be made to approach more closely an exact science. Speed and skill in distribution are absolutely requisite for successful results. Delays, errors, and omissions are made at a ruinous cost. The nearer you get to the consumer, the more tortuous the path, the more exacting the demands, and the more complex the problems.

Sales organizations covering the markets of the world, large and small, are necessary. The daily feeding of even the 100,000,000 consumers of the United States, mostly located in congested centers, is a nice problem. "Give us this day our daily" supply of fresh fruits and vegetables does not mean giving a week's supply to-day and being left without supply a week hence. The perishable food products from orchard and garden must, like the manna of old, be furnished fresh every day, excepting Sunday.

Producers, through Government aid and otherwise, are organizing and cooperating among themselves and for themselves. The question is, Can the producer be expected to look out for himself and at the same time give equal and fair consideration to the rights, demands, and preferences of the consumer? The wholesale and retail buyers or middlemen in mercantile capacity must safeguard the consumers' interests. The burden is upon them to furnish their communities with adequate and regular supplies, and it is well known that a successful merchant, either wholesale or retail, must undertake to supply his customers with products of the same quality and at the same or lower price than any competitor. It is therefore questionable whether one factor—that is, the producer and his organizations—can justly fulfill all trade requirements as well as can be done by maintaining the independent middlemen, who, to be successful permanently, must act in a measure for the consumer.

It is not to be expected that California growers will furnish New York a full and adequate supply of oranges when higher prices are obtainable in western markets. It is for the independent middleman, on behalf of the consumer, to go to the uttermost parts of the earth to secure for his customers the best product at the lowest cost. We see in the markets to-day such a common article as onions from New York State, from Egypt, and from Spain.

The wholesale dealer, like the share cropper, is on a profit-sharing basis instead of straight wages. To exist and thrive, he must serve acceptably either the consumer or the producer, or perhaps both.

It is apparent that the problems which arise in the movement of products from producer to consumer are numerous and serious in a business where the goods are not only perishable but very bulky. There is a very apparent necessity for separating the business into distinct departments, managed on a profit-sharing basis, preferably with the managers of the different departments being stockholders or partners. This, in effect, is the status at present; but instead of harmony and cooperation prevailing and the interdependence of each being recognized, the disposition has been to feel that the interests of the producer demand the elimination of his profit-sharing employee, the buyer.

"Confusion worse confounded" has resulted, particularly during the past 15 years, because the Government, railroad officials, bankers, and others, speaking from a theoretical standpoint of the problem of marketing and distributing farm products, have started at the wrong end. They have grabbed the bull

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by the tail and attempted to remedy troubles by reforming conditions at the marketing end, instead of beginning at the point of production.

Our Government has now recognized this, and under the present administration the office of Markets and Rural Organization of the United States Department of Agriculture is operating most effectively and efficiently. Information is being disseminated and a campaign of education benefiting every factor connected with the fruit and produce business, has been inaugurated.

Every unnecessary middleman or factor between the producer and consumer should be eliminated. This elimination should proceed in an evolutionary manner, rather than by revolutionary methods. The entire machinery of transportation and distribution should be operated to the end that car-lot supplies may go direct from producing point to the smallest consuming points, as far as practicable. There must be genuine cooperation extending all the way from producer to consumer.

There are approximately 10,000 carlot buyers of fruit and produce in the United States. These buyers are just as anxious for a supply as the producers are for a demand. To bring about greater confidence and cooperation between the growers and these 10,000 car-lot buyers is very desirable and will go far toward solving the problem of distribution. The establishment and maintenance of a stable, extensive, and profitable market for fruit and produce depends, first, as already stated, on the quality and character of the product and "pack," and the satisfaction it gives to the ultimate consumer. The extent of the demand, which regulates values, depends upon satisfying the consumer both as to price and quality.

While expert salesmanship ordinarily secures highest market prices, proper distribution looks farther ahead and disposes of a normal supply to all available markets in such a manner as to maintain the largest possible volume of demand. Some variation and elasticity in price position is necessary to secure such proper distribution . The practice of pooling results, on the part of distributors, when fairly worked out in every detail, tends to stabilize the business, since it takes care of this variation in prices in the different markets. However, the pooling system, too often shields reckless and careless methods of sale and distribution.

Normally, increasing price means decreasing demand; also increasing price insures increasing supply, and vice versa. Hence the great necessity of regular schedules and equitable distribution. If price is allowed to become a cause instead of an effect, it makes the owner of the products a slave, rather than a master of his market. With reliable market information in the hands of the expert, supply and demand may be measured or weighed and prices so adjusted that a proper balance is maintained.

The ability of a large selling organization to know the right price at the beginning and throughout the season insures the confidence of both buyer and grower, which confidence is absolutely essential to facilitate the car-lot distribution of our perishable foods. Desirable apportionment of cars to logical markets is often greatly hampered by the asking or quoting of unreasonably high prices. The same demoralization results from quoting unduly low prices, which results in large blocks of fruit and produce going into the hands of wholesale speculators. The selling agency that can and does name the correct price, or closely approximates it, commands the respect and confidence of the trade. This ability, together with square dealing, is essential to good results. In naming the correct price, the sales agency must have reliable, authentic, complete, and up to the minute information as to competitive and other crops,

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general business conditions in the world markets, the possibility of changes in the competitive crop situation because of storms, etc., and the ability to make the right deductions from all this data. The efficient distributor ought to be able to see much farther ahead than either buyer or grower, and the ability to convince both as to the correctness of the sales agency's price position and to get them to act accordingly is necessary and possible.

There must be sufficient elasticity and adaptability in car-lot distribution to meet changing conditions. Whether a purchase is made f. o. b. shipping point or delivered in the market, cooperation and assistance must be rendered the buyer, in the matter of ventilating or refrigerating the product in transit, selecting the quickest routes, tracing cars to destination, engaging space for foreign shipments, insurance, etc. The ability to book orders with exacting requirements often facilitates direct distribution to certain buyers, who, for instance, may want only one size of apple, grapefruit, or orange.

It is a much more satisfactory process to sell standardized goods from a catalogue, or by letter or wire description, at an f. o. b. price, than to consummate sales after examination of the goods themselves in the markets. Delay in distribution results from the necessity of such examination. Unavoidable differences in quality and condition of perishable goods, which often occur in the case of f. o. b. sales, generally can be equalized by an adjustment in dollars and cents—a comparatively simple matter in the work of a well-organized selling agency where reliable facts are easily ascertained.

Judicious advertising tends to bring the buyer to the goods, thereby greatly simplifying distribution. An organization can often finance advertising of this nature when the individual grower and shipper can not. Most of the 10,000 car-lot buyers of the United States, as well as those of foreign countries, are more than pleased to see any large volume of fruit and produce in the hands of competent and reliable sales organizations, whether formed of producers or so-called middlemen, since the buyer's interest and the producer's interest are, after all, identical, and organized selling when honestly conducted protects both.

Because of the perishable nature of the products and the loose methods and ideals of many growers and dealers, errors are often made, the total cost of which is great. The conclusion of the whole matter may be summed up as follows: Car-lot marketing and distribution is accomplished most satisfactorily when the distributing organization, be it composed of growers or middlemen, has the confidence of growers, buyers, retailers, and consumers, as well as bankers and railroads. To justify and retain this confidence and cooperation necessitates an honest and intelligent effort to consider and respect the rights and interests of each.

## TRADING IN GRAIN FUTURES.

By L. D. H. WELD,

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In view of the conclusions reached by numerous Government commissions and independent scientific students during recent years, it is hardly necessary to discuss the problem of future trading in grain for the purpose of determining whether or not it is economically justifiable. There are still, of course, many

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people who do not believe in future trading, and there are also very few outside of the grain trade who really understand it. The principal problem of to-day is how best to eliminate certain evils connected with future trading and the extent to which the Government should attempt to do this through legislation. To adequately consider this problem, however, it is first necessary to state as briefly as possible the functions of speculation, with special reference to the use of the futures market for hedging purposes. This will clarify the situation for a consideration of the question of Government regulation.

It is convenient and illuminating to summarize the functions of speculation under the three following heads: First, it largely makes possible the shifting of risks from the actual merchandisers of commodities to a body of professional risk takers; second, it aids in regulating the rate at which the year's crop is consumed by adjusting the price level according to supply and demand (past, present, and future); third, it aids in regulating the flow of commodities from producing to consuming regions by adjusting prices between different markets. Be it noted that it is only claimed for speculation that it aids in the two functions of price adjustment over a period of time and over different markets at the same time; the great development of means of communication and the facilities for acquiring and disseminating market information fundamentally make these price adjustments possible, but it is the speculative market that furnishes the machinery through which the actual price adjustments are largely brought about. As a result of these three functions, the cost of marketing commodities that may be bought and sold for future delivery is reduced to a minimum.

The most important function of speculation is the shifting of risks from the shoulders of the actual merchandisers of grain to those of professional risk takers. This is accomplished principally through "hedging," or the purchase or sale of commodities for future delivery to offset or to protect an equivalent sale or purchase of actual commodities. In this connection it might be well to bring out the relation of the terms "future trading" and "speculation" which are often used interchangeably. Although there is some element of risk involved in any transaction calling for delivery at a future time, yet a certain kind of future trading has come to be called "pure speculation" in contradistinction to that kind of future trading which is undertaken for the purpose of protecting transactions in actual commodities. In pure speculation commodities are bought or sold for future delivery solely for the purpose of obtaining profits from price fluctuations; in hedging, the purchase or sale is made for the purpose of avoiding profits and losses from price fluctuations, or, more properly speaking, to offset a fall (or increase) in cash price by a corresponding increase (or fall) in the price of the future. In other words, hedging is undertaken to avoid speculation. As will be pointed out below, hedging is dependent on the existence of a speculative market, and hence it is proper to speak of the "functions of speculation."

It is unnecessary to explain in detail in this place just how hedging operations are carried out, but since no one can hope to think intelligently on the subject of speculation in grain without having some conception of the idea and purpose of hedging, a few of the simplest examples will be given to make its meaning clear.

In the marketing of eggs there are many dealers who buy up eggs in large quantities during April, May, and June, and who put them into storage for use during the following winter when egg supplies are scarce. Those who speculate in this way have no means of protecting themselves; when they buy them in May they have no idea what price they will receive the following December.

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As a matter of fact, in some years they make large profits, while in other years they suffer heavy losses. If egg dealers, when they buy eggs in June at 20 cents, could at the same time contract to deliver them at 24 cents the following December, they would be glad enough to do so, because in that way they would be avoiding risk of price fluctuations in the meantime. But there is no future trading in eggs except in a small way; the quality that will be delivered the next December is not definite enough to permit buyers to take a chance in purchasing for forward delivery, or an unusually large supply of fresh eggs may depress the price during the following December, so that the dealer would lose money on those that he had engaged six months before.

Conditions are entirely different in the wheat market. A large terminal elevator buys up a million dollars' worth of wheat in October. If there were no market for futures, the terminal elevator would have to do just as the egg dealer does—sit back and pray that the price will go up instead of down, and up enough to pay interest, insurance, and cost of operating his elevator, as well as yield a fair profit. But the terminal elevator company has to take no such chances. When it buys wheat in October at 90 cents per bushel it immediately turns around and engages to deliver it the following May at 95 cents, thus assuring itself of a sufficient gross profit to cover the carrying charge and yield a profit, whatever may happen to the price in the meantime. Competition of terminal companies is so keen for this apparently safe kind of business that the price of the future is often so little above the cash price as to make it difficult to figure where any profit may be made. In fact, during some years of short crops the demand for cash wheat is so insistent that the price for future delivery does not rise high enough above the cash price to enable the terminals to make money. Under such circumstances they, of course, stay out of the market and lose some money because their capital invested in elevators in lying idle.

When a terminal operator sells for future delivery wheat bought as cash wheat he has hedged his cash holdings. It makes no difference to him whether the price goes up or down before the month of delivery arrives. Of course, if it should go up considerably, he would have made more money by not selling for future delivery, but by hedging he waives possibility of a large profit by protecting himself against a possible loss. People are willing to buy wheat for future delivery because they know exactly, or almost exactly, what they are going to get. Each exchange decides for itself what grade of wheat shall be delivered in fulfillment of future contracts; i. e., it decides on a contract grade. In spite of certain shortcomings the grading systems have been brought to such a high state of efficiency that this is possible. Wheat is more susceptible to standardization than almost any other agricultural product. Corn and oats can also be finely graded, and consequently can be bought and sold for future delivery. Not so with barley and rye, and therefore these grains are not ordinarily handled in this way.

But the terminal elevator operator is not the only one that hedges. In fact practically every handler of actual wheat, including the country elevator, the cash buyer, the shipper, the exporter, and the flour miller uses the future market for hedging purposes. The terminal elevator operator in the example cited above hedges his holdings by selling for future delivery. The flour miller frequently hedges by buying for future delivery. Suppose that during October a miller is asked to figure on 10,000 barrels of flour to be delivered the following June. Possibly the United States Government is contracting for future supplies. The miller will not make the flour until the following May, and he can not tell how much he will have to pay for cash wheat at that time. So

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he looks at the price of May wheat—i. e., the price of wheat for May delivery—and figures on that basis. When he closes the contract he immediately steps into the pit and buys enough May wheat to make his 10,000 barrels of flour. It makes no difference to him what happens to the price of cash wheat in the meantime; he has his wheat all engaged at a definite price, and he knows that it will be delivered to him.

So much for illustrations of shifting risks by means of hedging. It is only the existence of a market for futures that makes this possible, and the market for futures would not exist if it were not for the presence of speculators who are ready to buy or sell at any moment during trading hours. Risks are not eliminated; they are merely shifted from the merchandisers of grain to a body of professional experts who are best qualified to shoulder these risks, just as fire insurance companies shoulder the risks of loss by fire.

It is unnecessary to dwell at length on the other functions of speculation in this place. The adjustment of the price level to actual conditions of demand and supply, although by no means perfect, is brought about very largely by the combined judgments of speculators who are the most expert judges of market conditions. By taking into consideration the size of the crop, the visible supply in warehouses, the probable rate of consumption, etc., they adjust the general price level in such a way as to prevent an under or over consumption of grain during the fall, with consequent surplus or scarcity during the following spring and summer. In other words, speculation tends to level prices throughout the year.

As for the adjustment of prices between different markets, this is also brought about mainly by speculative transactions. This is accomplished by buying futures in one market and selling simultaneously in another whenever the difference in prices is in the least abnormal. This is called "arbitraging" or "spreading." The prices in various markets throughout the world are kept in such nice adjustment in this way that wheat flows almost automatically from producing regions to consuming sections. There are no alternate gluts and scarcities in different markets as there are said to be in the case of peaches or strawberries or even potatoes.

With these considerations in mind, let us pass to the question of Government regulation. In the first place, it is to be noted that the United States Congress has already passed a cotton futures act (1914), aimed to regulate trading in cotton futures. This law is regulatory, and not prohibitory. Furthermore, there were certain conditions in the cotton market which called for drastic treatment, but which do not exist in the grain market. The most notable difference between the speculative markets in these two commodities has to do with the contract grade or grades. It has already been explained that future trading in wheat is possibly largely because the buyer for future delivery can know just what grade he is to get. Such a large proportion of the total supply of wheat falls within a narrow range of quality that one, or at most two, contract grades furnish a sufficient quantity for the fulfillment of future contracts.

Not so in the case of cotton. Cotton is of such a variety of qualities, and the total supply is distributed so evenly among the different grades, that no single grade furnishes a sufficient quantity for the fulfillment of future contracts. The prices of cotton for future delivery refer to "middling," but this is only a basis. If middling had to be delivered in fulfillment of all future contracts the market could easily be cornered. To overcome this difficulty it is provided that the seller of cotton for future delivery may deliver any one of a number

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of grades, some better and some poorer than middling. If he delivers a better grade, he must have a premium; if a poorer grade, a discount. The difficulty comes in determining the "differences" for the grades above and below middling. In New York these differences were fixed arbitrarily by a committee of the exchange. The buyer of cotton for future delivery not only did not know what grade of cotton would be delivered to him, but he didn't know whether he would be allowed to pay a fair price for what he did get.

Because of this important difference in the characteristics of the two commodities, wheat is much better adapted to future trading than cotton, and the principal reason that caused the Government to attempt the regulation of cotton speculation does not exist in the case of wheat. There are, however, other matters that raise the question of the desirability of Government regulation of grain speculation, which I shall attempt to bring out in the following discussion.

Those who hold views as to the advisability of governmental action with respect to future trading may be roughly divided into three classes as follows: First, those who believe that only evil results from future trading, and who would therefore have it prohibited altogether; second, those who realize that important economic benefits are derived from hedging, and who would therefore permit future trading so far as hedging transactions are concerned but who would prohibit "pure speculation"; and, third, those who realize that hedging transactions are dependent on the existence of a purely speculative market, and who realize that speculation has other functions than the mere shifting of risks, and who therefore believe that speculation as it exists to-day should be allowed to continue. This last class of people may also be roughly divided into two classes, viz: First, those who believe that the Government should keep its hands off entirely, and, second, those who believe that certain evils can be cured by wise legislation without injuring the general features of the system. These different sets of opinions will be discussed in order.

Those who would prohibit trading in futures believe that the evils which they see—some real and some imaginary—far outbalance any possible benefits that may be derived. All trading in futures is looked on as pure, unadulterated gambling. They depict in heartrending terms the stories of suicides, murders, and defalcations caused by losses in the speculative market. They ordinarily believe that short-selling has the effect of fictitiously increasing the supply of commodities, and that therefore the general result is a lowering of the prices that farmers receive. They point with scorn to the corners that have been engineered by individuals or by small coteries of operators, with consequent artificial raising of prices for the benefit of the few. They also point to the continuous fluctuations in prices even during a single day as prima facie evidence that the laws of supply and demand no longer control prices, and that price fluctuations are caused by "manipulation" among the speculators.

These views demand attention. In the first place, the most serious evil of grain speculation is undoubtedly the drawing in of ignorant outsiders, who are foolish enough to "dabble in wheat." It can not be denied that great misery has often resulted from such participation in grain speculation, just as it has in real estate transactions and other forms of speculation. The high degree of organization that has been attained in the speculative markets, the low brokerage rates that are charged for the execution of orders, and the small margins that are required, make it easy for the general public to speculate in grain if it so desires. The fact that many brokerage houses solicit such orders from people outside the grain trade, and maintain branch private-wire

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houses to encourage the placing of speculative orders, makes it doubly easy for people to speculate, and even induces many people who would otherwise not be tempted.

But speculation in grain on the part of the irresponsible public has been appreciably decreasing during recent years. There are many firms of brokers who no longer solicit this business, and who accept unsolicited orders only after a careful consideration of the financial and moral responsibility of the persons placing such orders. In some of the grain markets, such as Minneapolis and Duluth, the exchanges openly frown on the solicitation of outside speculative orders. The waves of speculation when everyone "took a flier" in wheat, so common 20 years ago in the American primary markets, have very largely passed. Speculation is falling more and more into the hands of those who are financially and intellectually capable of assuming the risks involved. Chicago is the great speculative grain market of the United States and of the world, and in that market hundreds of irresponsible outsiders are enticed into or allowed to enter the game. But even in that market there has been an increasing tendency, especially among the older and more reliable firms, to pay more attention to the character and qualifications of the people who wish to speculate.

In general the stories of misery resulting from grain speculation are greatly exaggerated. The great bulk of future trading is carried on by men who are best qualified to assume the risks involved, and who operate with great caution and with keen judgment based on a continual study of market conditions. Professional speculators ordinarily content themselves with extremely small profits on single transactions and, when obliged to, take correspondingly small losses. Those who are in the market all the time rarely go either short or long even over night. They assume the risk-bearing function in extremely small doses, just as the risk of loss of a single vessel on a single trip is assumed by a large number of separate underwriters at Lloyd's, whereby each insurer shoulders a small proportion of the total risk involved. That irresponsible outsiders dabble in grain is unfortunate; that conditions in this direction are improving is certain; more definite action to improve conditions is desirable and undoubtedly possible, as will be pointed out below.

The claim that speculation through short selling amounts to a fictitious increase of supply and consequent lowering of price is hardly worth considering in this place in view of the effective way in which this argument has been disposed of by other writers. In short, those who argue in this manner forget that for every short sale there must be a corresponding purchase, and that the short seller sooner or later operates to defeat his own desire to see the price fall by having to reenter the market to "cover."

Neither is it necessary in this paper to dwell on "corners" as furnishing an argument for the prohibition of speculation. That corners are undesirable and demoralizing can not be denied. But successful ones are very rare; even attempts to corner the market are rare. When they do occur they have only a temporary effect, and this effect is more on the future price than on the spot price. Furthermore, the exchanges themselves are opposed to corners and try to make them impossible. In Minneapolis, the largest spot wheat market and the second largest speculative grain market in the United States, there has never been a corner of any importance.

The claim that constant price fluctuations are prima facie evidence of artificial manipulation of prices, and that changes in demand and supply can not possibly cause these price changes, is worthy of more extended consideration in this place. Agitators in the American wheat regions often use this argument



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with telling effect on their farmer audiences. They call attention to the zigzag diagrams published in the daily papers depicting the price fluctuations of wheat during a single day. They fail to point out, however, that the scale on which these diagrams is drawn is in eighths of a cent, and that what appear to be violent fluctuations on the diagram may cover not more than a total range of half a cent during a day.

As a matter of fact, the more highly organized the marketing machinery for any commodity, the more frequent are the price fluctuations, but the less severe are they. The great grain exchanges furnish perhaps the best example of this. During trading hours there are being constantly registered in the form of bids and offers the expert opinions of scores of the best qualified judges of market values. Every item of news from any part of the world affecting crop conditions (on the supply side) or affecting industrial conditions (on the demand side) has its immediate effect on the bids and offers in the trading pit. There are always those who want to buy pitted against those who want to sell; there is tremendous pressure from both sides; between these two great forces the price itself quivers along, susceptible to the slightest extra pressure from either side. But an increased pressure in either direction is quickly followed by a reacting pressure from the other side (i. e., as the "bulls" liquidate or the "shorts" cover), and as a result the price, in spite of constant fluctuations, normally remains within an astonishingly narrow range for days or even weeks at a time. Even when there are special reasons for a change in price level, such as the outbreak of a war or a prolonged drought, the price is apt to become adjusted to the new conditions more or less gradually rather than abruptly.

This condition is not found in the marketing of those commodities where traders do not come together in an organized market place or where the facilities for gathering and disseminating market information are not so highly developed. In the case of potatoes, for example, the dealers do not come together to do their trading; transactions are carried out by private sale and individual bargaining. As a consequence, the price is not so definite; it is not so susceptible to changes in supply and demand. It continues for several days or weeks without change and then abruptly goes up or down 5 cents a bushel. Prices are determined most accurately in the organized exchanges where speculation takes place; a constantly fluctuating price is an indication of a high degree of competition rather than of a lack of competition. Those who argue otherwise fail to understand the workings of a highly organized market place.

So much for those people who would abolish speculation in grain futures. They exaggerate the evils that do exist; they believe they see other evils which in reality do not exist; they fail to understand the functions of speculation. Many farmers are found in this class who would abolish speculation; there is always a certain amount of agitation for the passage of laws which will bring about such abolishment, and certain States of the United States have passed laws to this effect. Through the influence of the agrarians, Germany passed prohibitory legislation in the nineties, but the general consensus of opinion seems to be that Germany's experience under this law has not been favorable. No other important nation has attempted it. The benefits derived from speculation appear to far outweigh the disadvantages; the disadvantages themselves have been growing less.

The second class of people who urge legislation with regard to future trading are those who have come to realize the great benefits accruing from hedging but who can see no good in pure speculation—i. e., the mere buying and selling of futures not for the purpose of protecting other transactions in actual grain but merely for the purpose of striving for profits out of price fluctuations. This

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theory is well illustrated by a law that was introduced and seriously considered in the Minnesota Legislature in 1915, which prohibited the sale of anything for future delivery unless the seller had in his possession at the time the actual goods. Similarly, when Federal legislation concerning cotton futures was being considered attempts were made to include provisions to prohibit or penalize purely speculative transactions, but none of them were incorporated in the law as finally passed. Among those who urge this kind of legislation are intelligent farmers and many business men, even grain dealers in smaller markets who are accustomed to hedging but who, at their distance from the large markets, can not see the benefits of pure speculation.

The difficulty with the advocates of this kind of legislation is that they fail to realize that hedging transactions alone would not make a futures market; in other words, that hedging is dependent on speculation. It is conceivable that hedging transactions alone might be so numerous and so evenly divided between hedging sales and hedging purchases that there might be a continuous and instantaneous market, especially if all such transactions were concentrated in the market in one single city. But even then there would be difficulties. As it is under the present system, a grain dealer or flour miller who wishes to hedge can do so at any moment during trading hours. If future trading were limited to hedging transactions, a flour miller who wished to purchase 50,000 bushels of wheat as a hedge would have to find some one at the same moment who wished to buy 50,000 bushels as a hedge. It is hardly likely that he would be successful. Furthermore, the buying up of large quantities of actual grain by terminal elevator companies in the fall results in a preponderance of hedging sales for future delivery over hedging purchases at that time of year, and during the spring the conditions are reversed. It is the pure speculator, always standing ready, who "takes up the slack," who furnishes the continuous market where hedging purchases or sales can be made in any moment and at any time. This dependence of hedging on the speculative market is not generally understood; it must be acknowledged before we can deal with the problem intelligently.

Finally, we come to that class of people who appreciate the benefits derived from speculation and who would not have it abolished. Among the foremost in this class are naturally the grain dealers and speculators themselves, most of whom are also opposed to restrictive laws of any kind which might be aimed at the suppression of the evils connected with speculation but without destroying the system itself. And here is really the crux of the problem: Is it possible to frame and pass legislation which will suppress the evils without injuring the structure? Most of the grain dealers and speculators feel that the speculative markets are such sensitive and delicately adjusted mechanisms that the Government can not hope to intrude without doing injury. They believe that the exchanges themselves are not only the best fitted to regulate future trading, but that they are doing all that can be done.

It is very true that the exchanges themselves are in the best position to eradicate the evils, and that whatever they have attempted to do, they have accomplished much more effectively than could have ever been done by legislation. And the exchanges deserve great credit for the part they have played in developing the high degree of honesty and efficiency that exist in the spot and futures grain markets of to-day. But the grain men are apt to be too self-complacent with the results they have achieved; they are too apt to look lightly on certain minor defects which they might improve; and they are inclined to pay too little attention to that portion of the outside world that is demanding that something be done to improve conditions.

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But the problem as to whether the Government should act at all, and, if it should act, how far it should go, is a difficult one. So far as corners or minor manipulations are concerned, it is undoubtedly better to leave these for the exchanges themselves to care for; and they have done perhaps all that could be expected of them. The bucket-shop evil, an excrescence of organized speculation, has been brought under fairly effective control by State laws, although the exchanges themselves are able to do this more effectively when they take the matter in hand themselves. It was not until the New York Stock Exchange, for example, determined to suppress bucket shops in stock gambling that real progress was made in eradicating this evil in New York City. One of the principal objects of the United States cotton futures act was to remedy the evils resulting from the methods used in New York to determine prices of other grades than "middling." No such legislation is necessary for the grain markets, because, as already pointed out, grain runs more uniform in quality than cotton and only one or two grades need to be deliverable on contract. Legislation establishing uniform grain grades is undoubtedly desirable, but that effects speculation only incidentally.

The question of Government regulation of grain speculation simmers down to the problem of dealing with the most serious evil—viz, the enticing of the irresponsible and ignorant outsider into the speculative market. As already explained, there has been a great improvement in this respect during the past 20 years, especially in certain markets where the grain dealers have had a gradual awakening of conscience. The time is undoubtedly ripe in certain States of the United States for constructive legislation along this line, notably in Minnesota, Wisconsin, Iowa, Nebraska, Kansas, and Missouri. The solicitation of speculative orders from the outside public might be definitely prohibited; the private-wire houses in localities where no grain markets are located might be abolished; even "up-town" offices or offices outside of the grain districts of the great primary markets might be done away with.

The great difficulty with respect to legislation, however, is the fact that the principal speculative grain market is in Chicago. Laws that might be feasible in other States might not be practicable in Illinois, and yet this is where an improvement is most needed. It would be very difficult to determine how far legislation might be attempted in this direction. Just how far is it desirable to discourage speculation by outsiders? Anything that will help to eliminate the dry goods clerk or the bank clerk from the speculative market is highly desirable. But how about the successful banker or business man, or even the well-to-do farmer, if he wishes to speculate?

The possibilities of remedial legislation along this line can not be safely considered until there has been more investigational work along this line. We need to know more about the methods and prevalence of soliciting speculative orders; the activities and usefulness of private-wire houses; the customs in the various markets with regard to the requirement of margins; the class of people that really do speculate; and the extent to which they speculate. No scientific study has been made of this problem, and yet it would undoubtedly be possible to collect such information. Many leading grain houses, who are farsighted enough to realize that more definite action must be taken, would cooperate with Government investigators in revealing the facts.

Not until we have this information can we decide how far we should go in trying to eliminate the evil of irresponsible speculation by means of legislation. It is safe to say that something might be done, but that the great danger would be in trying to go too far. After all, the exchanges themselves are in the best position to improve conditions, and in many cases they are doing so. But

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the improvement brought about by the exchanges is very gradual; any single exchange hesitates to take drastic steps because of the fear of driving speculative orders to other markets, and the relative backwardness of the Chicago market in discouraging irresponsible speculation acts as a stumblingblock for more rapid progress in other markets. From this point of view national legislation would be more desirable than State legislation. But, even aside from the question of constitutionality of Federal laws, it would appear to be more the function of the exchanges themselves and the States in which they are located. The two things that are most needed are scientific investigation of the problem and the arousing of a feeling of responsibility among the members of the great grain exchanges.

In conclusion, it may be said that the great grain exchanges of the United States and their systems of future trading mark perhaps a higher development of marketing machinery and a higher standard of efficiency than has been achieved in the marketing of any other commodity. The mechanism is highly delicate and might easily be deranged by the clumsy finger of the Government. Although the evils of irresponsible speculation have been grossly exaggerated by the opponents of future trading, they are nevertheless real, and call for careful consideration and investigation and possibly governmental action.

## TRANSPORTATION OF PERISHABLE COMMODITIES—NEED OF COOPERATION BY SHIPPERS WITH CARRIERS.

By EUGENE F. McPIKE,

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The conservation of human food products is a national problem of great importance in all countries, including the United States, where, in spite of abundant natural resources, the people are experiencing the high cost of living. It is essential, therefore, to reduce to the lowest possible minimum any economic waste in the handling of all perishable commodities which, in a high degree, are so necessary a part of the sustaining power of any nation. The American railroads have made constant and strenuous efforts to perform their full part of the work of supplying the requisite facilities for the proper transportation of the goods to market. They have done even more than this, for they have invaded the wilderness and with unbounded faith in the future have projected their rails into the most uncultivated regions, which have been converted into fields of great productive usefulness, supporting new populations exporting to their neighbors far and near the constantly increasing surplus of the products of the soil. The natural growth of the population of the United States and the rapid increase from year to year in the production of fruits and vegetables and other perishable articles have caused the railroads to be confronted with many difficult problems of unparalleled magnitude.

There are in actual operation in the United States to-day more than 100,000 insulated refrigerator cars equipped with ice bunkers. There are single railroad systems which transport considerably more than 1,000,000 tons of perishable freight per year. The business as a whole, therefore, is large enough and of such nature as to require very close attention. The American railroads have not been backward in equipping themselves to handle the perishable freight traffic satisfactorily and with due regard to its importance and its peculiar

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requirements. It is entirely safe, therefore, to predict that in the future the railroads will continue to manifest in a substantial form their interest in that class of traffic. In fact, the transportation of perishable commodities has such a special hazard of its own as to make it imperative that great care and diligence be used, as indeed are almost invariably used, by the carriers which, in America, under the common law, are virtually the insurers of the freight intrusted to their custody. It may be true that from a technical or legal standpoint the American railroads are not actually the insurers of perishable freight to the same degree or in the same sense as they may be insurers of other nonperishable freight, yet in actual practice, all things being equal, the shippers of perishable commodities do generally rely upon the railroads to give safe transportation to such products and to deliver them on the market in as reasonably good condition as their inherent nature and the normal circumstances of transportation may permit. This situation, as to the liability of American carriers, is in some respects quite different from the responsibilities imposed by law or by custom upon the transportation companies in France and other countries of Europe. The American carriers are not, however, liable for any losses or damages to perishable goods in transit, the proximate cause of which may consist in one or more of what are generally known as the exemptions of the common-law rule and which exemptions may be briefly stated as follows:

1. Acts of God.
2. Acts of the public enemy.
3. Acts of public authority or law.
4. Acts of negligence of shipper.
5. Inherent nature of the goods.

It has also been possible and still is possible under the existing laws of the United States regulating interstate commerce for a carrier under certain conditions to enter into a valid contract whereby its liability may be limited, provided such contract or limitation is not contrary to any specific provision of law or public policy and is not unjust or unreasonable.

It follows, therefore, that in tendering for transportation any shipments of perishable goods there is still a considerable responsibility which necessarily rests upon the shipper himself and which includes various items for the proper handling of which it is essential that there be some active cooperation by the shippers with the carriers in order that the safe transportation, which is mutually desired, may be made possible. The shippers are responsible for the proper preparation of their goods for shipment with due regard to their inherent nature; the shippers are responsible for the proper packing, loading, stowing, stripping, bracing of carload freight, and for its proper and specific description as well as for reasonable, definite, and legible shipping directions. If the shipper faithfully performs his duty in all these respects he is sure of receiving substantial rewards in the more expeditious and satisfactory handling of his goods and in higher market prices. It is desirable, therefore, that the local agents of the railroads at the loading stations should endeavor to secure the constant cooperation of shippers, who will generally be glad to give it because their interests and those of the carriers are mutual.

### PREPARATION.

The proper preparation of freight for shipment is of itself alone a large subject because if sufficiently analyzed it would often take us so far back as the selection and treatment of the soil, the choice of seeds and plants of such character as would be best fitted to meet the local conditions of climate, etc., the

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subsequent cultivation and the care which must be used in picking and sorting. Excellent results were accomplished in California and other sections in consequence of the very extensive series of experiments made by the Bureau of Plant Industry of the United States Department of Agriculture. It was shown by those experiments that if the primary conditions are not up to a high standard and if the fruit is not carefully picked and handled so as to keep it free from bruising, there is no amount of subsequent service in transit which could possibly overcome the evil effect of wrong handling at the start. It is also of vital importance that the shippers of commodities such as strawberries should exercise extreme care in the operation of their packing houses, so that any berries which must be rejected on account of fungus or other defect will not be placed where they can by any possibility injure or contaminate other good fruit, whether already picked or still in the field.

In the handling of organic perishable freight containing animal tissues, such, for example, as dressed poultry, it has been demonstrated by the Food Research Laboratory of the Bureau of Chemistry of the United States Department of Agriculture that unless all the animal heat shall have been gradually and completely withdrawn from the product before it has been finally chilled or frozen, there is no amount of subsequent refrigeration in transit by carriers which can prevent the arrival of such goods in a tainted condition on the market at final destination. These conditions are very well understood by all the larger shippers, who have, therefore, equipped themselves with adequate facilities for the precooling of such products in the proper manner. In some other instances, however, the shippers of similar traffic in smaller volume have not so fully placed themselves in position to insure the proper preparation of their goods before tendering them for transportation. The conditions in this respect are constantly improving, and it is much better understood now than it formerly was that the carriers can not be expected to assume responsibility for any losses or damages which may arise from the failure of shippers to prepare their products properly for transportation. The Interstate Commerce Commission in the case of the Georgia Fruit Exchange *v.* Southern Railway et al., decided April 11, 1911 (20 I. C. C., 627), said that the railroads in their tariffs undertake to supply refrigeration, "but this can not be interpreted as an offer on their part to overcome physical conditions and characteristics that are natural to the traffic. Nor can it be interpreted as an assumption of the burden of preparing the freight properly for shipment. Some responsibility rests upon the shippers to improve the conditions under which their traffic is offered for transportation. The experiments conducted show that this can be done to the great benefit of the shipper and the carrier alike, and also to the benefit of the public." It seems to be admitted also that the carriers have a fundamental right to refuse to accept for transportation any freight, particularly perishable goods, which have not been properly prepared so as to permit of safe transportation to ultimate destination. The producers and shippers, however, have very strong incentives to prepare their freight properly for shipment, thus insuring the safe arrival of their goods at destination and the highest market prices therefor.

### PACKING.

Preliminary to packing but directly connected with it is the question of proper sorting and grading of the goods as to quality so as to insure a reasonably uniform standard of condition. A vigorous campaign of education has long been waged to impress upon the shippers the importance and necessity of using suitable containers for the different fruits and vegetables and other

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perishable products tendered for transportation. To some extent, it is still unfortunately a fact that the shippers in certain sections of the country continue to use insecure or fragile packages with the unavoidable result that their goods do not arrive on the market at destination in as satisfactory condition as the products forwarded by shippers in other sections who have adopted modern and standard methods of packing similar articles. Only experimental tests will show exactly what method of packing is best suited to the different fruits and vegetables and other perishable goods, but in a general way it may be said that when such articles require any ventilation or refrigeration in transit they should be so packed as to permit of some circulation of air within and through the individual packages. There are some differences of opinion as to details, but it is very evident that if commodities, such as strawberries, are too closely packed together in a tight crate without sufficient spaces between the boxes, they are very much more apt to overheat and spoil than if packed so as to allow a greater circulation of air inside the package. Another illustration might be given in respect of celery, which is sometimes loaded so that the tops are wedged in together, thus absolutely preventing any refrigeration or ventilation, so that as a natural consequence the tops decay very rapidly. It has been suggested that celery should be loaded upright—that is, with the foliage at the top—the same as when growing in the field, and that a space of about 3 or 4 inches be allowed between each row; furthermore, that one-half inch strips should be placed between each layer, and then the center of the load should be braced to prevent shifting.

### LOADING, STOWING, STRIPPING, AND BRACING.

These four items are so closely related to each other that they may be properly considered together. The rules in the official classification, southern classification, and western classification require that when any temporary lining or false floors, racks, supports, or other portable dunnage are used, they must be furnished and installed in the cars by the shipper and at his expense. The Interstate Commerce Commission's decision of June 12, 1914, about dunnage (I. & S. Docket 354; 30 I. C. C., pp. 538–546), said in substance that carriers are not obligated to furnish nor assume the responsibility of furnishing portable dunnage, and that it is not the duty of the carriers to load, strip, and brace carload freight at their expense. In other words, the service of loading, furnishing material, and placing in the cars is an additional service over and above the transportation, for which the carriers are entitled to receive reasonable compensation. In this connection reference is given also to the case of Davies *v.* L. & N. R. R. Co., 18 I. C. C., page 543. Therefore, if the shippers of perishable freight in carloads desire to keep their goods above the car floor, either to permit circulation of air under the load or to break the frost line, or for any other reason, it is essential that the shippers shall install suitable false floors at their own expense. If the shippers fail to do this the carriers can hardly be expected to assume liability for any consequent loss or damage by heat or cold. It is also the privilege and duty of the shipper to line the car with paper or otherwise so far as in his judgment may be required, with due regard to the character of the lading and the climatic conditions which may reasonably be expected to be encountered in transit to ultimate destination. The freight, if in bulk or in packages, should be carefully handled during the loading and stowing, and so placed and securely braced as to insure against falling down in the car in transit. When freight in barrels is to be loaded in more than one tier, care should be taken to see that the second tier is so placed as to prevent any shifting or any damage to the lower tier. It is also of the greatest importance that suitable strips be placed

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between individual tiers and rows of packages, such as strawberries in crates, so as to allow for the necessary circulation of air throughout the entire lading of the car. The material used by shippers for false flooring, bracing, and stripping should be of sufficient dimensions and strength as to avoid any breakage in transit.

The loading of a car to within a few inches of the ceiling is a dangerous practice, which is more or less used by certain shippers; and it has a very detrimental effect upon various commodities, such, for example, as celery, by reducing the air circulation in the car or by restricting the refrigeration when used. It has been suggested that celery should not be loaded higher than three crates in order to insure the best and safest transportation.

The proper height to which to load various different commodities has been or can be determined by actual experimental tests, which, of course, should be made for this purpose. It may be true that this feature of the matter is related somewhat to the question of the carload minimum weight applying on such commodities according to the legal tariffs. It may be observed, however, that in the case of the Georgia Fruit Exchange, which has already been mentioned, and in which the shippers applied to the Interstate Commerce Commission for a lower carload minimum weight in order that a less quantity of peaches might be loaded into the car, for the purpose of securing greater space and more circulation of air between the packages, the commission refused to order the carriers to reduce the minimum weights, and stated, on the contrary, that it was the privilege and the duty of the shippers so to prepare their goods as to permit the loading thereof up to the tariff minimum weights per car (20 I. C. C., 628–630).

### DESCRIPTION OF FREIGHT.

It is often of considerable importance that a complete and specific description of the goods tendered for transportation shall be given by the shippers to the agent at point of origin. For example, "fresh meat" should never be described simply as "meat." Hams, dry salt meat, sweet-pickled meats, etc., should be specifically described by their proper name in full without the use of any abbreviations, such as "P. H. P." for packing-house products. The different kinds of fruits and vegetables should always be separately specified, so that at all times it will be possible for railroad employees who may have custody of the waybills for such cars to know precisely what commodities compose the shipment, and thus be able intelligently to give the proper service to the freight.

### DEFINITE AND REASONABLE BILLING INSTRUCTIONS.

No one knows so well as the shipper himself the exact condition or state of maturity of his perishable goods at the time of loading and it is of the highest importance therefore that the shipper should give some reasonable and definite instructions concerning the desired refrigeration, icing, ventilation, or other authorized accessorial service in transit as may be provided in the carriers' tariffs applicable. The act to regulate interstate commerce provides that refrigeration, icing, ventilation, and other instrumentalities of transportation shall be furnished by the carriers upon reasonable request therefor. The Interstate Commerce Commission in a case decided February 18, 1915 (33 I. C. C., 295), declared that—

The need for ice varies with the condition of the shipment when loaded and the method of loading. Ripe fruit needs more refrigeration than green; cold-

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storage fruit more than fresh; fruit grown in a wet season more than fruit grown in a dry season; fruit loaded five tiers high more than fruit loaded three or four tiers; and fruit without spaces between the crates more than fruit loaded with spaces between the crates.

Carrier's employees at the icing stations ordinarily are familiar with none of these matters, especially with respect to particular shipments.

The carrier "can not be expected to substitute the discretion or judgment of its employees for the more expert knowledge of the shipper as to the requirements of particular shipments. It clearly appears that if complainant (the shipper) seeks only the right to give instructions that cars shall be iced at certain stations or that they be kept iced to destination, they already have such right under the present rules by specifying any regular icing station or by inserting in the bill of lading the notation: "Reice to full capacity at all regular icing stations."

In cases where shippers of semiperishable commodities, such as apples or cheese, for example, may desire to have the freight move without any refrigeration or icing in transit, it is important that they include in their billing directions to the agent at point of origin one of the notations of a negative character such as the following:

Not under refrigeration; do not ice or ventilate.
Not under ventilation; do not ventilate or ice.

It is very unwise for the shippers of any perishable freight in carload lots to neglect or omit to give some reasonable and definite instructions in writing to the carrier's agent at loading station. In other words, it is essential that the waybills which accompany perishable freight in transit should always clearly show some reasonable and definite instructions about refrigeration, icing, ventilation or other authorized service which is desired. When the shipments are to be forwarded under the provisions of tariffs which contain stated refrigeration charges per car, per package or per 100 pounds of freight, it is necessary only for the shippers to declare in writing whether or not their freight is being tendered for transportation under refrigeration, because in such cases the subsequent details of refrigeration as to the reicings in transit will be looked after satisfactorily by the carriers. In other cases where the shipments are forwarded under ventilation or under tariffs which provide a charge for the sevice of icing or reicing by carriers on basis of a price per ton or per 100 pounds of ice, the shipper should give in writing one of the standard notations, as the case may be, as follows:

Reice to full capacity at all regular icing stations.
Reice to full capacity at all regular icing stations with crushed ice and — per cent salt.
Put in hatch plugs, close hatches and other ventilators when temperature falls below freezing; open hatches and ventilators and take out hatch plugs immediately the temperature rises above freezing.
Close ventilators when temperature falls below freezing; open ventilators immediately the temperature rises above freezing.

In the case of certain commodities, such as cabbage or cheese, for example, it has been the practice of some shippers to ice the car initially at loading station and then to forward the shipment to some distant market with instructions "Do not reice in transit." The shippers may have been able in this way to save themselves a little money for subsequent refrigeration in transmit, but there is considerable hazard involved in that procedure, and it has generally been thought that the railroads should be permitted to furnish reasonably efficient refrigeration in transit and to collect their lawful charges for such service so furnished without any unnecessary restrictions, because in this way the best and safest transportation of the goods would be assured. The carriers

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do not and in the nature of things can not guarantee time in transit and there are various contingencies of transportation which may arise for which the carriers are not responsible and they should not be under any restrictions from the shipper which would forbid them from giving adequate protection to the property by refrigeration in transit.

In cases where the shipper of perishable freight in carload lots has neglected to give any instructions whatever as to refrigeration, icing, nonicing, or ventilation in transit, the carriers probably would have the legal and moral right to provide suitable service in transit to keep on the safe side and to collect their lawful charges for such service so furnished in good faith, unless the shipper had given a negative notation forbidding any icing or other special service.

On shipments governed by tariffs, which provide a rate per ton or per 100 pounds of ice, it is generally the practice of the initial carriers in most sections of the country to give to the shipper the privilege of using other reasonable and definite notations at owner's risk of loss or damage by heat or cold, and among such authorized notations are the following:

Reice at —— and ——.
Reice at —— and —— with crushed ice and — per cent salt.
Keep ventilators open to destination regardless of weather.
Keep ventilators open to —— regardless of weather.
Keep rear ventilators open to destination regardless of weather.
Keep rear ventilators open to —— regardless of weather.
Keep ventilators closed and plugs in to destination regardless of weather.
Close ventilators and put plugs in at ——.

It is very important that the shipper should never use any unreasonable, indefinite, or ambiguous and, therefore, dangerous, notations such as the following:

Reice when necessary.
Keep iced.
Keep fully iced to destination.
Reice every 24 hours.
Under ventilation.
Close ventilators if necessary.
Vents closed.
Vents open.
Vent if necessary.

There are also serious objections against what is commonly called side-door ventilation, which is a dangerous practice that many believe should be absolutely discontinued or discouraged. The side doors of refrigerator cars while in transit should remain closed.

### PROTECTIVE SERVICE AGAINST FROST.

With the exception of a few territories, the railroads of the United States have not officially recognized nor undertaken the practice of furnishing heated car service in transit, but under the provisions of certain rules published in the Official Classification, Southern Classification, and Western Classification, the carriers give the shippers the privilege of installing their own heaters or stoves, linings, false floors, etc., and of sending a caretaker in charge of the car. Furthermore, the shippers can often so prepare and pack their freight or wrap individual packages in such manner as will reasonably insure protection against possible freezing in transit. In other cases the shippers may prewarm the car by placing a lighted heater therein before and during the loading of the goods, and then the heater may be removed just before the car is sealed and sent

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forward. Other shippers use straw packing in the ends and center of car, particularly with such commodities as eggs, and the straw packing, if properly used, will minimize risk of both breakage and freezing. The combination of some of these different methods is used by various shippers. In cases of this kind the carriers do not hold themselves out as being prepared or in readiness to supply artificial heat in transit and therefore it is presumed that the shipper assumes responsibility for loss or damage by heat or cold not the direct result of any actionable negligence by carrier. According to a rule of law, which is more or less generally recognized, the carrier will not be liable for loss or damage by freezing unless by some act or negligence on its part. (6 Cyc., 381.) A carrier is not liable for failure to furnish any service not contemplated by its legal tariffs duly filed with the Interstate Commerce Commission. (C. & A. *v.* Kirby, 225 U. S. 155.) Any alleged agreement which is not in accordance with lawfully filed tariffs on interstate commerce is unenforcible. (A. T. & S. F. *v.* Robinson, 223 U. S. 173.)

It is evident, therefore, that on an interstate shipment the carrier can not be held to be guilty of negligence for merely failing to supply heated-car service not provided for in its tariffs, even though the property arrives at destination in a frozen condition on account of severe weather in transit. In such cases the tribunal of original jurisdiction is the Interstate Commerce Commission and not the courts, because the United States Supreme Court has declared that the Interstate Commerce Commission is the body established by Congress to which any complaints must necessarily first be made against any unreasonable provision concerning services furnished in connection with interstate commerce. In other words, it follows, therefore, that the question of whether or not the carrier has provided for proper service in its lawfully filed tariffs is something over which the Interstate Commerce Commission and not the courts have original jurisdiction. Under these circumstances it is not easy to see upon what grounds any Federal court would attempt to hold a carrier liable for loss or damage by freezing of interstate shipments when the carrier is free from negligence and has otherwise furnished all the service contemplated by its tariffs duly filed with the Interstate Commerce Commission. The volume of perishable freight traffic requiring any protective service against frost is very small in many sections of the country and is probably too small to justify the carriers in going to the expense of officially recognizing such service by publishing rules accordingly in their tariffs which, if done, might involve the investment of a considerable sum of money for the purchase of heating apparatus, etc.

The furnishing of heated-car service by carriers is, however, authorized by tariffs published by certain railroads in Maine and by the western trunk lines and North Pacific coast lines. In the two last-named territories the tariffs give the shipper the privilege of making his own choice between two options; that is, option No. 1, shippers' protective service, and option No. 2, carriers' protective service. In the case of shipments transported under the provisions of option No. 1, the shipper assumes all responsibility for loss or damage by heat or cold not the direct result of the actionable negligence of the carrier. In the case of cars moving under option No. 2 the carriers assume the liability for loss or damage by heat or cold not the direct result of the actionable negligence of the shippers. It is true that the Cummins amendment of March 4, 1915, to the act to regulate commerce purports to provide that a railroad can not by any contract, rule, or regulation escape liability for loss or damage "caused by it"; but the Interstate Commerce Commission, in a case decided May 24, 1915 (Docket No. 6731, 34 I. C. C. 157), said that where the heater

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service is performed by the shipper and loss or damage results from frost or overheating not the direct result of the negligence of the carrier, such loss or damage is not caused by the carrier, and it follows, therefore, that such tariff rule does not violate the Cummins amendment.

A similar view of the dividing line between shipper's responsibility and carrier's liability in such cases was expressed by the commission February 2, 1914 (I. & S. Docket 172; 29 I. C. C., 507), to the effect that while the Carmack amendment to section 20 of the act to regulate commerce provides that no contract, receipt, or regulation may exempt a carrier for liability for any loss or damage "caused by it," such amendment did not prohibit the carrier from entering into reasonable contracts with the shippers for a release from liability as an alternative to other tariff provisions under which the carriers will accept this responsibility themselves. Therefore at that time the commission declared to be fair and reasonable the tariff rule published by carriers, under which the shipper was allowed a choice between shipping his goods at a lower rate under a special contract by which he became his own insurer against weather loss or damage or of making his shipments under terms imposing full responsibility upon the carrier.

The only suggestion made by the commission was that the carriers in the wording of such tariff rules should make it plain that they were not seeking to escape liability for loss or damage resulting directly from actionable negligence of the carrier. Under all these circumstances it is of direct advantage to the shippers to use special care in the preparation, packing, wrapping, loading, stowing, etc., of perishable goods which may reasonably be expected to encounter freezing weather in transit.

### SUCCESSIVE USE OF ICE AND HEATERS.

A special problem involving peculiar difficulties of its own has been created by the movement of certain fruits and vegetables during the late fall months to stations in Canada from points in California or Florida, where, on account of climatic conditions prevailing in the producing territory, the use of refrigeration is required and requested by the shippers. Such cars during their movement into or through more northern zones may encounter freezing weather, and it has been found impracticable for the carriers to interfere or intervene by the substitution of any artificial heat to take the place of such refrigeration requested by the shippers. It has been thought that any such intervention would necessarily be in violation of the shipper's instructions, and that under section 1 of the act to regulate commerce the carriers are obliged to furnish refrigeration or icing "upon reasonable request therefor." Furthermore, experience has shown that in such cases the interruption of refrigeration by the substitution of artificial heat may cause the vegetables to wilt, or do more harm than good; therefore the carriers, generally speaking, do not feel obligated to assume liability for loss or damage to perishable goods by freezing in transit when at the request of shippers the freight has been transported under refrigeration. There is not yet known to be any practicable method whereby fruits or vegetables forwarded from a point in a warm zone to a point in a much colder zone can be kept at a uniform temperature or otherwise fully protected. An American inventor is now engaged in the perfecting of a mechanical process by means of which he proposes to maintain a constant temperature within an insulated car in transit by means of a thermostatic control.

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RECONSIGNMENTS AND DIVERSIONS.

When, under the authority of carriers' tariffs applicable a carload shipment of fruits and vegetables or other perishable freight is reconsigned by the owner of the goods, the reconsigning order should include proper instructions as to refrigeration, ventilation or other authorized service and such instructions, but not in conflict with the authorized notations just explained, should be entered on the billing accompanying the freight, the previous instructions thereon to be "Canceled" or "Reaffirmed," and signed by the carrier's local agent or employee actually making the reconsignment or diversion. It may be technically true that from a legal standpoint the carrier would be fully justified in complying only with the original shipping directions given by the shipper at the first loading station because to him was given the bill of lading and he is virtually the agent of all subsequent owners of the same shipment, whether moving on basis of a through rate or the combination of local freight rates, so long as the identity of the shipment is preserved. As a matter of safety, however, it has been found desirable that in cases of reconsignments or diversions, particularly when there is any change of ownership of the goods, there should be some renewal of old instructions or some new instructions of a suitable character given as to the requisite refrigeration, icing or special service beyond the point of reconsignment.

PROMPT LOADING AND UNLOADING OF INSULATED CARS.

The shippers and consignees can also greatly help the carriers and at the same time be of great assistance to themselves as a whole by promptly loading and unloading all special equipment, such as refrigerator or other insulated cars of which the number in service however large, is necessarily limited. It is unfair to the shippers as a whole for any one shipper or consignee to detain such special equipment any unreasonable length of time for his own personal convenience. Other shippers of fruits and vegetables, etc. may be waiting for insulated cars to be placed for loading but the carriers are powerless to supply such cars at all times unless every shipper and consignee throughout the country will meet and fulfill the moral obligation resting upon him to unload and release such cars with the utmost promptness. The Interstate Commerce Commission in the Track Storage Case, decided July 7, 1915 (35 I. C. C. pp. 33–35), said: "A consignee of freight has no legal right to use a car as a warehouse or storage plant."

For the carriers as a general practice to permit individual shippers or consignees to detain refrigerator and other insulated cars unduly might amount virtually to discrimination against the other shippers and consignees who may be in great need of similar cars to take care of like traffic. The correctness of this principle has been quite fully set forth by the office of Markets and Rural Organization of the United States Department of Agriculture in an interesting bulletin relating to "Demurrage," which was published in March, 1915. Under these circumstances and in order to avoid or minimize such possible discrimination in the supply and use of insulated cars, the carriers have in various sections of the country adopted somewhat higher charges for detention or demurrage on such cars as distinguished from the very low demurrage rate of only $1 per car per day applying on ordinary equipment.

The handling of perishable commodities is a subject having many peculiarities of its own which require very close and constant investigation and supervision in order to insure satisfactory results. The carriers themselves are not at all unmindful of the special duties and obligation resting upon them to use all

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reasonable care and diligence in the transportation and safe delivery of perishable goods. The principal shippers, being experienced in their own business, are also fully alive to their own special duties and obligations. It remains only to bring about a still more general understanding of the requirements of perishable freight traffic and at the same time an even greater degree of cooperation between shippers and carriers than has heretofore existed; only in such united efforts will it become possible to achieve the maximum efficiency of service and the minimum of economic waste which is mutually desired and which would certainly be for the public interest.

The people of the United States from the Atlantic to the Pacific Ocean and from the Canadian borders to those of the Republic of Mexico or the gulf bearing the same name, are living as a single nation. Their cities are supported and the population thereof are fed not so much by the rural districts which immediately surround them as by the country as a whole. The consumers in New York or in Washington, our Federal capital, are as much accustomed to having upon their tables the products of Florida, Georgia, Alabama, Louisiana, Mississippi, Texas, California, and Oregon as the products produced in the fields much nearer at home. The carriers of the United States under such conditions have been confronted with the gigantic task of giving safe transportation to all kinds of perishable commodities, many of which are exceedingly delicate in character and must be hauled for distances of 1,000, 2,000, or even 3,000 miles. That they have been able on the whole to perform this task in a reasonably satisfactory manner argues well for their average standard of efficiency of service. Under our common law no man is expected to do the impossible; neither should the carriers, as such, be expected to do the impossible. They will undoubtedly continue to maintain the highest possible efficiency in their service, but this will be largely in vain unless the shippers collectively will also exercise the utmost care in the preparation, loading, and forwarding of the goods. This they will certainly be willing to do, for thus they will conserve and protect their own interests. No man has a right to destroy his own house by fire, for that we call arson, which is a crime. On the same high moral grounds involving the public interest no man has a right deliberately or willfully to destroy fruits and vegetables or other perishable goods, even his own, for they form a part of the common wealth of the Nation at large which is entitled to the conservation of the means of its own sustenance.

BIBLIOGRAPHY.

The following list does not duplicate any references to decisions by the Interstate Commerce Commission, etc., which may appear as a part of the text of the foregoing paper:

1. Liability of Common Carriers: Limitations of Common Law Provisions as Affected by the Interstate Commerce Act. By Francis B. James. (The Traffic World, Sept. 20, Oct. 4, Oct. 11, Oct. 18, 1913, Vol. XII, pp. 552–555, 634–636, 671–674, 704–706.)

2. Ditto, continued. (The Traffic World, May 15, 1915, Vol. XV, pp. 1069–1077.) This supplemental article by Mr. Francis B. James relates particularly to the question of carriers' liability as it may be affected by the Cummins Act of March 4, 1915.

3. Laws and Regulations Affecting the Transportation of Perishable Goods, as to Shippers' Duty and Carriers' Liability. By Chas. Conradis. Presented before the Sixth Section of the Third International Congress of Refrigeration,

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Chicago, September, 1913. (P. 24.) This article was reprinted in The Traffic World for 1913, Volume XII, pages 592, 624.

4. Laws and Regulations Affecting the Transportation of Perishable Goods as to Shippers' Duties and Carriers' Liability. By Henry C. Nicholson. Presented before the Sixth Section of the Third International Congress of Refrigeration, Chicago, September, 1913. (P. 20.)

5. The Organization of Agriculture. By Edwin A. Pratt, London; Jno. Murray, 1908. (P. 443, including index.)

6. The Granger Movement: A Study of Agriculture Organization and Its Political, Economic, and Social Manifestations, 1870–1880. By Solon Justus Buck, Ph. D., Cambridge; Harvard University Press, 1913. (P. 384, including index and a comprehensive bibliography.)

7. The French Garden: A Diary and Manual of Intensive Cultivation. By C. D. McKay, F. R. H. S., published by the Daily Mail, London. (P. 61, with illustrations.)

8. Cooperation in the Handling and Marketing of Fruit. By G. Harold Powell. (Yearbook of Department of Agriculture for 1910, pp. 391–406; Y. B. Separate, 546.)

9. A Study of the Improvement of Citrus Fruits Through Bud Selection. By A. D. Shamel, U. S. Department of Agriculture, Bureau of Plant Industry, Circular 77, issued June 2, 1911.

10. The Precooling of Fruit. By A. V. Stubenrauch and S. J. Dennis. Yearbook of Department of Agriculture for 1910, pages 437–448; Y. B. Separate, 550.

11. Studies on Fruit Respiration. By H. C. Gore, U. S. Department of Agriculture, Bureau of Chemistry, Bulletin 142, issued August 4, 1911.

12. The Handling of Fruit for Transportation. By G. Harold Powell. Yearbook of Department of Agriculture for 1905, pages 349–362.

13. The Decay of Oranges While in Transit from California. By G. Harold Powell, U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin 123, issued March 31, 1908.

13½. The Relation of Handling to Decay in California Navel Oranges; Season of 1910–11. By A. V. Stubenrauch. U. S. Department of Agriculture, Bureau of Plant Industry Bulletin, issued July 13, 1911. (P. 7.)

14. Italian Lemons and Their By-Products. By G. Harold Powell and E. M. Chace. U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin 160, issued October 6, 1909.

14½. Handling and Shipping Citrus Fruits in the Gulf States. By H. J. Ramsey. U. S. Department of Agriculture Farmers' Bulletin No. 696, issued November 10, 1915. (P. 28.)

15. Promising Root Crops for the South. By O. W. Barrett, United States Department of Agriculture, Bureau of Plant Industry, Bulletin 164, issued February 5, 1910.

16. How to Kill and Bleed Market Poultry. By M. E. Pennington and H. M. P. Betts, United States Department of Agriculture, Bureau of Chemistry, Circular 61, issued August 13, 1910.

17. Studies of Poultry from the Farm to the Consumer. By M. E. Pennington, United States Department of Agriculture, Bureau of Chemistry, Circular 64, issued December 9, 1910.

18. The Comparative Rate of Decomposition in Drawn and Undrawn Market Poultry. By M. E. Pennington, United States Department of Agriculture, Bureau of Chemistry, Circular 70, issued March 23, 1911.

19. The Refrigeration of Dressed Poultry in Transit. By M. E. Pennington and A. D. Greenlee. Presented before the Fifth Section of the Third International Congress of Refrigeration, Chicago, September, 1913. (P 7.)

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20. Perishable Goods. By J. M. Culp, Vice President, Southern Railway. Presented before the International Railway Congress, Berne, Switzerland, July, 1910. (P. 84.) This paper presents comprehensively the different practices of the railroads of the United States, Canada, and other countries using the English language.

21. Perishable Goods. By Richard Bloch. Presented before the International Railway Congress, Berne, Switzerland, July, 1910. (Pp. 85–209.) This article is an exhaustive account of the methods used by the railroads in France, Germany, and other European countries for the transportation of perishable goods.

22. Program of the Commission on Transportation. By Richard Bloch. Presented at the Second International Congress of Refrigeration, Vienna, Austria, October, 1910. (P. 30.) This article also relates to the methods used by European railways for handling perishable freight.

23. The Refrigerator Car—Retrospective and Prospective. By J. H. Bracken. (In "Transactions of the American Society of Refrigerating Engineers"; Vol. IX, pp. 137–149, followed by discussion; New York, 1913–14.)

24. The Refrigerator Car—Retrospective and Prospective. By Eugene F. McPike, *Ibid.*, Volume IX, pp. 125–136, discussed jointly with Mr. Bracken's paper above mentioned.

## OPPORTUNITIES AFFORDED THE RAILROADS OF THE UNITED STATES FOR PROFITABLE AGRICULTURAL DEVELOPMENT WORK.

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The railroads of the United States are so differently organized and managed and the extent of the territory they serve is so vast and so varied that many of the methods employed in the United States would not be practicable in all Pan American countries.

The information contained in this paper, however, may be of interest to the members of this congress in showing how close agriculture and transportation, the two greatest industries of this country, are allied and how some recent legislation primarily intended to promote agricultural development provides an agency by which the railroads also may benefit greatly.

The Federal agricultural extension act of May 8, 1914, commonly known as the Smith-Lever bill, makes it possible for all State and national agricultural agencies of the United States to get into closer touch than ever before with the individual farmer, and it should prove an important factor in making farm life more attractive and profitable. It has been characterized as one of the most valuable educational enactments ever passed by the United States Government.

The means it provides for reaching the remote farmer through actual demonstration on his own premises of the best farm and household practices also should stimulate production greatly. None perhaps, except the farmer, will benefit to a greater extent from this increased production than the railroads. The railroads of the United States should therefore be especially inter-



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ested in seeking to determine in what ways their activities may now best be directed in order that they may derive the greatest benefit from this increased output of the farms.

### COOPERATION WITH AGRICULTURAL AGENCIES.

A share of the department extension funds, money derived from State, county, and local sources, and a portion of the Smith-Lever fund have been devoted to the maintenance and extension of the county agent system. Extension work in each county will be in the charge of a county agent, who will act as the joint representative of the local community, the State through its agricultural college, and the Nation through its Department of Agriculture. It is believed that in this way the need of the agricultural people in their several communities can be best determined, and whatever help the State and the Nation can give them in their agricultural and home problems can be most speedily and effectively brought to them.

On the whole, these county agents have been very successful in winning the support and confidence of the farming people, and the tangible results of their work are very encouraging. The personality of the agent is, of course, a very large factor in determining the measure of his success. His understanding of the real problems of the region in which he is working, his sympathy with rural people, and his ability to meet them on their own ground and actually to convey to them important practical instruction and information in a convincing way are among the essentials. When to these qualifications are added studious inclinations and habits, the possession of accurate and up-to-date knowledge of the practice and science of agriculture and business ability of a high order, we have a very able and useful man, whose services should mean much for the agricultural and social advancement of his county.

Over 1,000 county agents, who will devote their entire time to demonstration work among the farmers, already have been appointed. It is estimated that this field force will consist eventually of several thousand trained agriculturists.

The railroads can actively cooperate with this immense force at comparatively little expense if they will but avail themselves of the opportunity. While these agriculturists are maintained largely at public expense, several railroads already have made them nominal employees in some localities by contributing a small portion of their salaries and in supplying them with free transportaton within the confines of the county under their jurisdiction.

The help already extended by the railroads is valuable, but so far they have failed apparently to obtain the full benefits that could be derived from the system. There is a tendency on their part to depend entirely too much on the initiative of the county agents rather than to actively assist in making a study of the agricultural conditions through the medium of these representatives. No exclusive employee of the railroad can hope to keep as well posted regarding agricultural conditions in detail in their particular localities as can the county agent, and the officials at headquarters, acting as a clearing house, could lend valuable aid in disseminating useful information regarding supply and demand in other localities. The railroads should be more free to give them advice and active help, not only to stimulate production and diversification, but to assist in devising better methods of assembling and marketing of the crops already produced.

### AID EXTENDED BY THE RAILROADS IN AGRICULTURAL DEVELOPMENT.

The railroads have done much in the past to assist in agricultural development and have been liberal in financing the operation of demonstration trains

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and experimental farms. They also have published and distributed a vast amount of educational literature regarding cultural methods and the use of fertilizers, and some of them maintain agricultural specialists to-day. But it must be admitted that comparatively few railroad officials, chiefly perhaps because of the multiplicity of their other duties, have given the subject of agriculture the sustained interest and study it merits. The earnings derived from the handling of agricultural products look small to many of them when compared with the revenue derived from other traffic often moving in larger volume the year round, and perhaps of a more competitive character, and they are too apt to feel that their time can be occupied better in other directions, often overlooking the fact that the increased prosperity of the farms brings in its wake increased tonnage in many commodities.

Conditions are changing, and it would appear that the railroads could now cooperate with the farmers more effectively along somewhat different lines than they have followed in the past. The mission of the agricultural demonstration train, for instance, to which the railroads generally have devoted most of their attention, seems to have been accomplished to a certain extent, and other methods are now likely to bring better results.

### MARKETING AND DISTRIBUTING PROBLEMS.

Marketing problems are inseparably connected with transportation questions and everything that helps the marketing question helps the railroads. Considered as a whole, the railroads have not the intimate knowledge they should have of the movement of agricultural commodities from producing to consuming centers. They could furnish very valuable help in securing more satisfactory markets, not only for the present production but also for the probable increased output of the farms tributary to their lines.

The railroads are less acquainted probably with the farmers residing along their rails than with any other class of their patrons. By delegating some of their officials to cooperate with the county agents and to accompany them frequently on their trips, attending meetings of farmers' associations and in many other ways, it would be possible for them to establish closer and more friendly relations with many shippers than ever before, and help them solve problems the very existence of which railroad officials do not now know.

Besides bringing them into more intimate contact with a large number of individual shippers along their roads with whom they now have little, if any, acquaintance, this plan offers unusual opportunities for them to establish friendly and harmonious relations with such shippers and with many State and national authorities. In the demands that are made upon them from time to time by their employees for higher wages one of the arguments with which they are confronted constantly is the increased cost of living, and it is one of the hardest for them to combat.

Certainly no other industry is concerned more vitally in keeping down the cost of foodstuffs. They could serve their own interests by assisting more actively than many of them do at present in helping to solve some of the problems of distribution. Such problems are arising constantly and are bound to become more numerous as production is increased. A better opportunity for real constructive work is not likely to present itself nor one that would require the expenditure of such a small amount of money. The railroads could take up work along these lines probably in no better way than by making practical surveys in producing communities, in cooperation with the county agents, and especially in such communities as have not yet had the benefit of cooperative organization. They could thus become more intimately acquainted with some

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of the marketing problems of the small farmer and help him to find a more satisfactory outlet for what he grows.

### CREATING NEW TRAFFIC.

A prominent railroad authority said recently:

We must recognize the fact that the railways are not yet doing as much as they might do and should do of the creative work needed to develop to the fullest practicable extent the resources of the territory tributary to their existing lines. * * * And after one has surveyed the entire situation in a broad way, he is apt to conclude that if as much money, energy, and thought were devoted to the creation of entirely new traffic as are expended in soliciting and dealing with rates on existing traffic the results gained would be quite remarkable.

He also said that what our new conditions require "is intensive treatment on the part of the railways if we are to expect to secure intensive development."

An excellent opportunity for just such "intensive treatment" is now afforded the railroads by helping to start produce moving from the farm, much of which is frequently said to be wasted for want of marketing facilities.

It also was suggested in an article which appeared recently in a railway journal that there is not only the opportunity, but the need for the railroads to establish a new department to be known as a "traffic creating department." It was pointed out that if such a department were put in charge of a man who had the imagination to enable him to see the possibilities of creating traffic development and the business experience and judgment to work out his ideas, that he could accomplish much to the financial benefit of his road and for the good of the communities served. It seems certain that the incidental good to the communities that would result would not be the least of the benefits of such an effort, if wisely and consistently prosecuted.

A study of the questions involved in the distribution of agricultural products would be a good beginning for such a department. There is no longer any apparent necessity for the railroads to devote so much of their energies toward an increase in the production of farm products and it can hardly be disputed that they could perform a service of far greater value if they would assist more actively in finding satisfactory markets for the crops already produced.

### EXAMPLES OF CONSTRUCTIVE WORK.

Cooperation is the keynote of successful marketing and in localities in which cooperative effort has not been attempted it undoubtedly can be most effectively encouraged by beginning in a small way. For instance, one railroad operating in New York State is doing some missionary work in this direction by advocating the building of storage sheds at country stations along its line. Such facilities are needed universally not only to prevent decay or deterioration, but in order to permit of the gradual distribution of the crops according to demand after the season of production. Without such facilities the farmer has to dispose of his products as soon as they are harvested. The particular railroad in question is advocating the building of cheap sheds for the storage of coal, fertilizer, lime, etc., in order to enable the farmers to purchase these commodities in carload lots and at the lowest price and to haul the commodities from these warehouses at their own convenience. A small beginning of this kind serves as a good object lesson in cooperative effort, and it seems only natural to expect that it would eventually result in developing more modern storage warehouse and cold-storage plants.

The producer would soon find that, with a place available in which to place his products for safe-keeping with the least possible delay, where they could

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afterwards be transferred to consuming centers at the most favorable seasons of the year, it would extend distribution over long periods. With this wider field for marketing, the farmer would most certainly obtain more satisfactory returns. In this work the railroads could do much to help him.

The particular railroad in mind has delegated an official to actively and constantly cooperate with the county agent. This official devotes his entire time to agriculture and the railroad has supplied him with an automobile so that he can cover his territory thoroughly.

Another good example of how the railroads can help may be illustrated by the work undertaken by an agricultural traffic club recently organized in a large eastern city. It is composed of representatives of railroads, express, and steamboat companies located at that point. It was organized to cooperate with various bodies engaged in agricultural work and it is an example worthy of imitation in other localities. The objects of this club are to stimulate the production of small things on the farm and to assist in the establishment of better systems of collecting and distributing farm products and especially to educate the farmers to the benefits of uniting in the marketing of their products.

Similar organizations could be formed in many different parts of the country and they should be able to obtain many interesting facts regarding agricultural questions from the county agent near at hand. While their activities would necessarily be confined at first to the consideration of questions more or less local in character, it would soon be found desirable for them to meet annually with other organizations of the same kind for the discussion of questions of greater scope. Under this plan the more intimate knowledge they would gain of agricultural conditions in their own vicinity would enable them to discuss more intelligently the problems of greater magnitude, which would be brought up at these annual meetings, and would help them to find a solution to these problems.

## CONCLUSION.

Both State and National Governments are appropriating large sums of money in trying to find better methods of distributing the products of the farm and it is time, therefore, that the railroads should take the subject in hand in earnest.

There is scarcely any venture they could undertake which offers such possibilities for good. It would not only increase their revenues, but it would also do much toward assisting in building up the prosperity of the territory they serve. Nor is there any venture from which they could obtain so much free advertising and publicity from the newspapers and cooperation in so many directions from so many different sources. There is probably no medium through which they can work more effectively than through the county agents appointed under the authority of the Smith-Lever Act.

As the organizations established in the various States are not uniform in all respects, however, any railroad official who may desire to get in touch with the work being done along their lines should communicate directly with the State directors of extension work and not with the county agents.

## BIBLIOGRAPHY.

Weekly News Letter, U. S. Department of Agriculture, September 22, 1915, Vol. III, No. 7.

S. O. Dunn: Extract from an address, "Old and new methods of developing traffic," delivered at a meeting of the Railway Development Association, Chicago, November, 1914.

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F. R. Stevens, "Farmers' warehouses," Annals of American Academy of Political and Social Science, November, 1913.
Traffic World, Chicago, August 14, 1915, Vol. XVI, No. 7.

## THE EXTENT AND POSSIBILITIES OF COOPERATION.

By C. E. BASSETT,

*Specialist in Cooperative Organization, Office of Markets and Rural Organization, United States Department of Agriculture.*

Practically every great achievement of man has been the result of cooperation, inasmuch as the word "cooperation" simply means the act of working together for a common purpose. No doubt much of this cooperation is involuntary in its nature, being brought about by the will of a majority expressed through the power of government, but as civilization has advanced men have discovered that if it pays to force men to work together for their own good and the good of the community, they should cooperate voluntarily because of the savings and profits to be derived thereby.

During the last few years a vast amount of very helpful history in business cooperation has been recorded in this country. While the record includes hundreds of failures, due largely to loosely organized associations, poor management, and the failure to recognize the simplest business principles, there are also many encouraging examples of success.

For many decades in this country cheap virgin soils made cheap production possible, so that the farmers felt only the need of concerning themselves with matters of large crop production; but higher land values, higher paid labor, the call for expensive fertilizers, and the increased expense of fighting insect and fungous pests, together with decreased yields in some cases, have emphasized the need of less expensive and more businesslike marketing plans. As a result of certain striking experiences a new faith has developed on the part of the American farmer that the cooperative plan of doing farm business is the most satisfactory method. In fact, the American farmer is being driven to cooperation by necessity.

While we hear a great deal of the extent to which cooperation in the marketing of agricultural products has been carried on in foreign countries, such as Denmark, Ireland, Germany, and others, from investigations which have been carried on by the Office of Markets and Rural Organization, it has been found that there are fully 10,000 organizations in the United States which are cooperative or owned by producers engaged in the marketing of agricultural products and in the purchasing of farm supplies. Included in this number there were fully 3,000 farmers' grain elevators, 3,000 creameries, 1,500 fruit and produce-shipping associations, and a miscellaneous list of about 3,000 whose operations include the storing and warehousing of farm products and the purchase and manufacture of farm supplies. Over $1,000,000,000 worth of products were marketed by these organizations the past season. From this it will be seen that American farmers are beginning to realize that by selling cooperatively they not only are able to offer a standardized product and reduce the cost of marketing, but they are able to furnish this better article to the consumer at the same or even at a lower price, thus stimulating consumption.

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In fact, any system of marketing that does not give better service or better prices to the consumer, and at the same time secure for the producer a greater net return, is founded on improper principles. The work of these American cooperative institutions includes the establishment of grades and standards, and, where possible, the adoption of brands and trade-marks; the securing of capital and credit; proper advertising; the encouraging of consumption of the meritorious but little-known product; the discovering of new and the extending of old markets; the securing of information as to crop and marketing conditions; the equitable division of profits; adapting production to meet market requirements; the utilization of by-products; the securing of cold and common storage facilities; the cooperative buying and manufacturing of supplies; the securing of lower freight rates, more equitable refrigeration charges, and more efficient transportation service; the securing of more and better labor; and the general cultivation of a spirit of cooperation and uplift in all community affairs.

It would be a matter of great pride to be able to report that this cooperative method of doing business has been adopted by our people because of the business soundness of the principle, but a careful study of cooperation in this country brings us to the conclusion that cooperation, as applied to the distribution and marketing of farm products, is seldom attempted and more seldom successful, except where such effort is the result of dire necessity. So long as farmers do fairly well in their own individual way they are not inclined to cooperate.

The producers of perishables grown at a great distance from consuming markets were early driven to cooperation by this necessity. The perishable nature of their products and the heavy transportation expenses compelled them to organize and stay organized in order to distribute and market their products in competition with points near the consuming centers. Such a condition as this accounts for the highly efficient organizations found in the Pacific northwest and California. That section which makes a specialty of some one phase of agriculture offers the most promising field for cooperation, since it gives the association the advantage of a large amount of one product, as in the case of cooperative elevators for handling grain, live-stock shipping associations, meat-packing houses, cooperative creameries and cheese factories, egg circles, cotton gins and warehouses, fruit and produce associations, and various others.

### LIMITATIONS.

*Loyalty of members.*—Having a highly specialized crop, grown in a narrowly restricted area, the successful marketing of the same under a cooperative plan is limited largely by the willingness of the producers to give up their individuality and to stand together under all temptations and discouragements, trusting at all times in the honesty and judgment of their officers, and especially in the skill and business ability of their manager.

It may be that a part of the success of cooperation in foreign lands is due somewhat to the training of the people, who, under a strong form of government, are more accustomed to take and follow orders than to give them, while in this country every citizen is taught that he is a ruler and is very slow to place himself in an organization where he is bound by certain fixed rules.

*Legislation.*—Under the existing statutes in most States the application of the cooperative principles to stock companies is difficult, for the reason that the corporation laws are for the benefit of man as a capitalist and not as a producer. Leaders of the cooperative movement throughout the country are endeavoring to secure the passage of laws by the States that will fix the simple

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standards of cooperation and provide for the control and protection of such organizations. Several States have adopted such laws, the principal requirements of which are: (1) Ownership and control by the producers; (2) one vote for each man or upon the basis of patronage, with no proxies; (3) the privilege for members absent from meeting to vote by mail upon specific measures; (4) the distribution of profits by paying not to exceed the local rate of interest on the capital invested, laying aside a small percentage for the creation of a surplus and to provide for depreciation of property and paying the balance of the dividends upon the basis of patronage to members, employees, and nonmembers, the latter to receive one-half the uniform patronage dividend paid to members; (5) the regulation and control of the transfer of stock or membership so as to prevent any person from acquiring control.

Another reason for the success of cooperation in foreign lands may be found in the fact that the business of cooperative associations in those countries is encouraged and protected by strong fostering laws which so control the use of association brands and labels that the effect is practically to force the producers into some one of the associations in order to secure the best markets. On the other hand, in this country cooperative associations have been placed on a level with all forms of capitalistic enterprises and have been subjected to the same restrictions, although their objects and methods are exceedingly different. Later legislation has sought to correct this mistake, and it may be that still further legislation will be necessary before cooperative organizations will be given the protection and encouragement which they deserve.

*A capable manager.*—The success of a cooperative organization is also limited to the ability of the manager in charge. He must be intelligent, diligent, experienced, and of good judgment, with tact and ability for keeping alive the enthusiasm, interest, and cooperation of the members. Excepting the disloyalty of members, inefficient management has been more responsible than any other factor for failures of cooperative organizations. This inefficiency is due to the lack of sound judgment in selecting a manager, to the poor salaries usually paid, and to the disrepute in which the position is held. The position of a manager in a cooperative marketing organization is difficult to fill properly, because it is undesirable. It requires the soul of patience and self-sacrifice to stand by the job in the face of the nagging to which the man who occupies such a position is usually subjected by the membership.

*Financing.*—One of the most important features of cooperative organization management is the method of financing the enterprise. The cooperative distribution of farm products is a serious business undertaking and can not live merely by reason of the beautiful principle of mutual help involved. Sums of money, more or less proportionate to the amount of business handled, are required for successfully operating the scheme, and it is therefore necessary that all the members contribute toward a sum sufficient for the needs of the business. In order to avail itself of the Clayton exemption clause to the Sherman antitrust law, a strictly cooperative association should be limited in membership to bona fide farmers and should have no capital stock. The necessary funds for conducting the business may be provided by membership fees and temporary loans.

*Membership agreement.*—It should never be forgotten that a cooperative association is no less a business institution, and must be conducted strictly upon business lines. Its stability must depend upon the constant support of its members, and this loyalty should not be a matter of sentiment, but should be secured under as strong a membership agreement as can be legally drawn. This agreement should set forth the terms of the relationship between the members and the association, and should be secured by a written contract

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signed by each member. While a penalty clause for a breach of this contract may be illegal, the member may be held accountable for any loss sustained by the association through a failure on his part to live up to his contract.

*Grades and standards.*—One of the greatest advantages of a cooperative organization is its ability to improve the grades and standards of the products of its members. Better prices and more regular business can be secured by an association because of the uniformity in quality and the enforcement of standards which furnish a common language between the growers and the consumers, and thus tends to place these products upon a stable basis in the markets. This applies particularly to perishable products.

*Bonding and auditing.*—Not only to protect itself against loss through dishonesty or carelessness, but also for the purpose of preserving the confidence of the members, every association should adopt most stringent rules, providing that all officers who handle any of the funds or property of the association shall give a surety bond in excess of the value of the property which they are likely to handle at any one time. The association can well afford to pay for such bonds. The books and business of the association must be audited frequently by competent persons, and an annual audit should be made by a qualified accountant previous to the day of the annual meeting. These frequent audits will tend to discover any mistakes in management before they have become serious, and frequent reports to the members will prevent unjust suspicion and criticism, which is so easily aroused among those who are not kept informed of the true state of affairs.

Cooperation as an economic principle is receiving the serious consideration of practically all industrial classes. Its application to special lines of agricultural distribution and marketing is entirely feasible and offers a fair solution of problems and difficulties that are practically hopeless in so far as the individual is concerned. Experience in this country has demonstrated that cooperation in agriculture is a corrective measure that will do much to place the industry upon a solid basis and insure the future happiness and prosperity of the Nation.

## Adjournment.

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## JOINT SESSION OF SUBSECTIONS 4, 5, AND 7 OF SECTION III.[1]

RALEIGH HOTEL,
*Friday afternoon, December 31, 1915.*

Chairman, C. S. SCOFIELD.

The session was called to order at 2.30 o'clock by the chairman.

Subsection 4 of Section III announced, through its chairman, Mr. Samuel Fortier, the final appointment of a committee on resolutions for the subsection—R. P. Teele, G. W. Sutton, Augustín Mercau, D. C. Henny, and S. H. McCrory.

Papers presented:

The poultry industry; its importance in agricultural development, by Harry M. Lamon.

What should be done for the settler, by I. D. O'Donnell.

Uniform grades and standard packages, by C. T. More.

Standardization of vegetables, by S. J. Cook.

## THE POULTRY INDUSTRY; ITS IMPORTANCE IN AGRICULTURAL DEVELOPMENT.

By HARRY M. LAMON,

*Senior Animal Husbandman in Poultry Investigations, United States Department of Agriculture.*

### DEVELOPMENT OF THE POULTRY INDUSTRY.

There is little definite knowledge as to the origin of the domestic fowl. It is assumed that our present-day poultry is a direct descendant of one or more of the wild jungle fowls which are known to have existed in prehistoric times. Whatever may be its origin, our earliest historic records indicate that poultry has been under domestication for thousands of years.

Judging from the nature of poultry keeping among our barbarous or semi-civilized races of recent times, it is probable that the domestication of fowls was first accomplished for the sport of cock fighting rather than for any economic reason. However, as the value of fowls as a source of food production became recognized they came to be kept more and more for this purpose primarily. In consequence, from those early times until fairly recent years the keeping of poultry has been a matter of supplying food for

[1] There was no stenographic report of this meeting.



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the family. There had been no incentive to keep a larger flock than would supply eggs and meat needed for the family, for the reason that transportation facilities were not such as to allow the surplus to be taken any considerable distance for disposal. What chance surplus there was came to be largely a medium of barter or exchange with neighbors or with the residents of near-by villages and towns.

However, with the advent of steam railroads and, more latterly, with the coming of cold storage, it has been possible to ship poultry and eggs long distances successfully, and it has also been possible to conserve the surplus produced in the natural breeding season, which is the spring of the year, until it could be disposed of during the season of scarcity, during the fall and early winter. This equalization of the supply and demand has had a most profound effect upon poultry keeping. It has made it possible for poultry keepers to dispose of surplus poultry and eggs during this season of flush production at a price which is profitable to them, where previously they would have been unable to get prices which made it worth their while. This evening of the supply has also kept down the price which the consumer has had to pay for poultry products during the season of scarcity, and has in consequence made poultry and eggs a food product within the reach of the masses during most or all of the year.

As a consequence of this condition the development of poultry keeping has gone beyond the point where the farmer or poultryman has limited the size of his flock to meet approximately the needs of his own family and has made poultry keeping one of the activities on the farm from which it is expected to receive an actual money income. It has also led in many cases to the development of special poultry farms where the keeping of poultry is the main activity. In some cases these poultry farms have reached a point where from 1,000 to 20,000 head of fowls are kept. Along this same line there has been a great development in duck keeping, and some of the large duck farms of the present-day market as high as fifty or sixty thousand ducklings annually.

While this development in poultry keeping has been largely a matter of natural economic conditions, there have been certain other agencies which have played a part. Thus the fairs and poultry shows where poultry has been exhibited have had a considerable effect in spreading interest in this activity and have therefore had a considerable influence on its development. The various Governments, and in the United States the State agricultural colleges and experiment stations, have of late recognized the growing importance of the poultry industry and by their experimental work and their teaching have done much to spread knowledge on this subject.

Something of the present-day development in poultry keeping may be realized from the development of certain communities which depend almost entirely upon the poultry activities of their inhabitants for their prosperity. Thus, for example, in the United States we find the Petaluma district of California. This is an area with a radius of approximately 16 miles, where about 1,500,000 hens, mainly single-comb White Leghorns, are kept for laying purposes. The production of poultry and eggs in this community is the chief agricultural asset. Another great poultry community in this country is the district known as Little Compton, in Rhode Island. Here the fowls kept are mainly the Rhode Island Reds. The farmers of this community depend on the poultry and eggs produced almost entirely for their income. It is noteworthy that in this section the methods used, while successful, are very primitive. At the present time in the United States there is in the making a third poultry community located at Vineland, N. J. Here in the past few years the keeping of poultry has increased from a point where a few thousand fowls were kept until at the present time

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it is estimated that 300,000 single-comb White Leghorns are maintained principally for the production of eggs for the New York market.

Belgium and Denmark are both known as countries in which the poultry industry has played a very important part, and the eggs and poultry sent out of these countries have been one of their most important agricultural exports.

### SIZE AND IMPORTANCE OF THE POULTRY INDUSTRY.

It has been usual to consider the poultry business as a little business. This has been due in part to the fact that most poultry is kept in comparatively small flocks on general farms. The relatively small size of these individual units has caused us to lose sight of the fact that these units exist on practically every farm, and that in the aggregate they form an industry which is of considerable magnitude. Thus, for example, we find that in the United States, according to the census of 1910, a total of over 5,500,000 farms reported poultry out of a total number of farms of a little over 6,300,000. The value of the poultry and eggs produced in the United States during this year was somewhat in excess of $600,000,000. This amount includes only the value of the poultry produced on farms and does not take into consideration the large amount which is produced in the villages and towns.

It is interesting to note in this connection that the leading agricultural States in the United States are also the largest poultry-producing Sates; and, to pursue this subject still farther, it appears that the leading agricultural counties in these States are likewise the greatest poultry-producing counties. From this it can be seen that general agricultural development and prosperity go hand in hand with poultry development. As a measure of the importance of the poultry industry in the United States we find that according to the census of 1910 the total value of poultry products produced each year is approximately equal to the value of the hay crop, is greater than the combined value of oats and potatoes, is six times the value of the tobacco crop, and is equal to that of the wheat crop.

What is true for the United States is likewise true for other countries. While we find it impossible to get many detailed statistics from other countries regarding the poultry industry, some information and some comparisons are available. In the year 1910 the returns from poultry to the farmers of Canada aggregated over $31,000,000. The improvement in poultry conditions for Canada is shown by the fact that the average value of all poultry produced in that country rose from 32 cents in 1909 to 36 cents in 1911, and the average number of fowls per farm increased from 32 to 42 head during this period.

Ireland has for years been famous for its butter, yet in 1909 the value of the poultry and eggs exported from that country to Great Britain was equal to £3,750,000 and was in excess of the value of exported butter by £128,000. The lord lieutenant of Ireland, in an address before a conference on poultry, stated that poultry has to do with and signifies prosperity in the homes of the people at large.

### POULTRY AS A FACTOR IN AGRICULTURAL DEVELOPMENT.

The poultry flock, particularly of late years, with the development of better methods, has proved to be a revenue producer practically all the year round. In many instances the amount of money received from the poultry has been surprisingly large, often sufficient to buy the food and pay for the clothing of the family. The money from the poultry, taken together with that from the other year-round revenue producers on the farm, such as butter, has therefore come to be a decided factor in providing for the physical welfare

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of the farmer and his family, and in many instances has gone still further and has become one of the chief agencies in helping to pay off the farm mortgage or other indebtedness.

It often happens that the care of the poultry flock becomes primarily the work of the farm women. Where this is the case the women frequently have control of a part or all of the income derived from the poultry flock. In such instances it will be found that much of this money goes for purposes which tend to improve conditions of life on the farm and to provide conveniences and comforts in the home. The money is also often used to further the education of the children and generally to broaden the life and outlook of the farm communities.

Poultry has played a not inconsiderable part in the building up of agricultural lands, as poultry manure is one of our most valuable fertilizers. One of the most striking examples of the influence of poultry in this manner can be found in the Campine district of Belgium. This district, which extends from the city of Malines east, was at one period an arid, sandy plain, covered with fir trees and incapable of cultivation. Mr. Edward Brown, the celebrated English authority on poultry, says of this section:

> Some 30 years ago poultry keeping was taken up in this section by the peasants on a somewhat extensive scale, although the land was poor, and the only conditions present favorable to poultry production were a possible outlet for the product, shade as furnished by the fir trees, and some natural food. In 1897 the author paid a visit to this district and found that in the greater number of instances the land had been so enriched by manure from the fowls that it was capable of cultivation. The fir trees had been cleared away, and market gardens for the production of vegetables formed upon the old woodlands. At that time it was freely acknowledged that this result was largely due to the fowls, which were being bred in greater numbers all over the Campine district.

The keeping of poultry has also had a decided influence on the introduction and keeping of better live stock in general. Because of the fact that it is relatively inexpensive, pure-bred poultry has been one of the first kinds of improved live stock to be introduced on the farm. The advantage of pure-bred poultry, both in the matter of increased production and in the production of a more uniform output, has in many instances called attention to the advantages to be derived from other branches of improved live stock and has resulted in its introduction.

Poultry has undoubtedly a favorable influence in controlling insect pests. The average farm flock is allowed its liberty, and the chickens range for a considerable distance over the farm hunting for food, much of which consists of insects of various kinds. In this way they help to keep down the noxious insects, and in certain instances, where they have the run of orchards and vineyards, they have a very decided influence in controlling the insects harmful to the fruit.

It may seem somewhat far-fetched to state that poultry has been an influence in introducing better methods of agriculture in general, yet such is the case. There is no more universal agricultural activity than the keeping of poultry. It also appears that the demand for information, as evidenced by the increase in the number of inquiries at the agricultural colleges and experiment stations, is as great along this line as any other, if not greater. The fact that the farmers are interested in securing information of better methods of poultry keeping unconsciously brings them into touch with better methods of agriculture along other lines. Their desire for information on poultry therefore serves as an entering wedge for the introduction of better methods in general.

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There has been considerable discussion in regard to the tendency of people to leave the farm for the city; and this has indeed been no fanciful condition. Poultry has had a considerable influence in counteracting this tendency, both in the way of keeping the young folks on the farm, and in bringing back to the farm many individuals from the city. There are few persons living in the city who have not at some time in their lives had an interest in poultry and a desire to go back into the country and engage in chicken farming. Probably in the majority of instances this ambition is never realized; but in many cases individuals do actually go back into the country and engage in this industry. Of course, some of them fail to make a success, but many of them do succeed, and where they do so poultry has been the means of increasing the agricultural population. Many of the boys and girls brought up on the farms have left them and gone to the city not only because of the fact that certain conditions of city life have proved attractive to them, but also because of the fact that while they were called upon to perform a considerable amount of labor on the farm, they seldom if ever had any direct interest in the farming operations or any share in the profit derived. However, poultry keeping has proved to be one of the things in which the young people are most likely to become interested, and in which they can be given a responsible part at an early age. It frequently happens that where a part or all of the care of the poultry flocks is turned over to the farmer's son or daughter, the whole or part of the income will be given them. Where this is done they immediately have an interest in the economic side of farm life, and one of the reasons for their wishing to leave the farm disappears.

In this connection it may be well to indicate one of the successful ways which is being used in this country to encourage the interest of the young people in poultry keeping, and consequently in farming in general. This is by means of the formation of poultry clubs, organized and maintained by the joint action of the National Department of Agriculture and of the agricultural colleges in the various States in which the work is carried on. Here the poultry club organizers go directly to the schools throughout the State, organize the members into poultry clubs, give them the very best information and help which they can on poultry keeping, frequently visit their homes, and do everything in their power to develop their interest in the subject, and to encourage them to keep poultry. It is worthy of note that the improved methods of poultry keeping instilled into the children usually find their way, through the children, to the poultry flocks of their parents.

As has been indicated before, practically every farmer keeps poultry. In consequence, practically every farmer has an interest in the problems which have to do with poultry keeping. This common interest in poultry, or in any other activity, agricultural or otherwise, must always have an influence upon communities by tending to bring together the individuals in the community and to unite their interests. While poultry is not by any means the only agricultural activity which has an influence along this line, it must be given credit for being one of the influences at work, and for having had much to do in bringing about community improvements, such, for example, as better schools and better roads and for promoting the social life of the community.

Poultry products, particularly eggs, are an ideal medium for promoting cooperative effort in marketing. This is due not only to the fact that they must be marketed frequently, but also to the fact that shipments are made to the best advantage in not less than case lots—that is, 30 dozen, and that the output from the average farm flock is not large enough to fill a 30-dozen case in a reasonable length of time, or while the eggs are still fresh. For this reason

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it is necessary that the shipments of two or more farmers be combined somewhere in the process of marketing. Previously this has been done largely in the country store or in the hands of some dealer. But the bad results that have obtained because of these methods have in many cases brought about cooperative marketing of eggs. Thus we find in the United States that there are now being formed egg circles among the farms of the community, having for their object the collection and shipment of eggs under the best possible conditions, with a consequent improvement in the price which the farmer receives. These egg circles or cooperative associations for the marketing of eggs have long been in successful use in Denmark, and are at the present time being introduced to a considerable extent in Canada.

From the formation of an association for the cooperative marketing of any product it is, of course, but a step to the cooperative buying of supplies needed by the members of such an association. Needless to say, this cooperative buying is following in practically all cases where cooperative marketing associations have been formed. It has been very difficult in the United States to bring about successful cooperative effort, but at the present time egg-marketing associations and cooperative creameries are successful examples.

As before indicated, poultry has become one of the agricultural subjects on which information is most frequently asked from colleges, experiment stations, or other governmental institutions having to do with the dissemination of better agricultural methods. For this reason poultry has been one of the most potent influences in bringing into touch with one another the farmers and these various governmental agricultural institutions.

## RÉSUMÉ.

We have seen that poultry has been domesticated from the wild state and kept to produce food, in the shape of meat and eggs, for the family. From this start the stocks have been improved, and as methods of modern transportation and storage came into use the flocks of poultry kept on the farms have been increased until they produced more than was needed for the use of the farmer's family, and this surplus has been sold in the cities and villages. In some instances the number of fowls kept on the farm has been greatly increased, until the production of poultry and eggs became the principal activity. However, these special poultry farms are comparatively rare, and the great bulk of the product is from the general farm flocks. While the individual poultry units are comparatively small, their almost universal existence on farms has resulted in an industry of decided magnitude—one which compares very favorably with any other form of agricultural activity.

The relation of poultry to general agricultural development has been very close, since poultry is kept on practically all farms. We find that not only has the poultry flock had a decided influence upon economic conditions on the farm, but has also been an influence in improving farm life, in building up agricultural lands, in helping to bring about the introduction of improved live stock; and has been a factor in controlling insect pests; has helped to introduce better methods of agriculture in general; and has had an influence in bringing our people back to the farm, as well as having an influence on community effort and spirit and in bringing the farmer into touch with governmental agricultural work and with agricultural literature.

There is no reason to believe that there will be any falling off in the consumption of poultry and eggs. On the contrary, there is every reason to think that with the gradually increasing cost of other forms of meat and with the better

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methods of marketing which are resulting in eggs and poultry of better quality there will be an increased consumption of both these products. In consequence, poultry will lose none of its importance as an agricultural activity, but will, if anything, gain somewhat in comparison with other crops. We have every reason to believe that, just as in the past it has had some influence in leading agricultural development to a higher plane, it will continue to do so in the future, and will be found to be closely linked with the improvement of farm conditions.

## WHAT SHOULD BE DONE FOR THE SETTLER.

By I. D. O'DONNELL,

*Supervisor of Irrigation, Department of the Interior.*

The settlement and development of vacant public lands and idle lands in private ownership is claiming the attention of the public in every country where such lands exist. Nations vie each with the other in attracting to the vacant lands within their respective boundaries people who are inclined to undertake the establishment of homes in new places.

So insistent have the various nations become in the matter of the immediate settlement of all available lands that resort is being had to innovations in the nature of special inducements to secure settlers. Lands have been tilled, houses have been built, live stock has been furnished, and loans of money have been granted, each and all with mixed success and failure.

A few generations ago there was no clamor for the immediate settlement of vacant lands. The settlement of new portions of a country was looked upon as a natural growth, and it was recognized that so long as there remained virgin lands the adventurous spirit of a restless race would search them out. The pioneers common to every country of the Western Hemisphere have since this hemisphere was discovered to the other half of the world pushed on and on, overcoming every obstacle to their possession of the new lands. Every mountain, stream, desert, plain, and forest saw their coming; the new places were peopled and the harvests made. The ways of these pioneers were uncharted; they knew hunger, thirst, sickness, and battle, and yet they settled the strange lands and made places in the wilds where their children might play. They had no help; they had no encouragement. It was the spirit of the pioneer that led them on. The fruits of their labors did not fall to them, yet they were satisfied; they blazed the trail. The doings of these pioneers are in the memory of men of to-day; and, notwithstanding this, we are come to the question, "What should be done for the settler?"

I believe the spirit of the pioneer still is strong in the peoples of the Western Hemisphere. Given time, this spirit would, without special assistance, build a home on every tract of land that would give up support for a home.

It appears, however, that the public demand for immediate utilization of all resources will not leave to the pioneer the pioneer's work. Many men influential in shaping the policies of governments advocate the creation of national organizations or bureaus to superintend the settlement of public lands along what may be termed scientific lines. It is their purpose to obviate mistakes and prevent loss of time in the development of the lands.

Under certain conditions it may be advisable for governments or land companies to extend to settlers aid, such as the breaking up of the raw lands, the

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building of houses and barns, the furnishing of live stock, and the lending of money; but, in the main, this would be done only when settlement of the lands is made under adverse conditions, such as unproductive soils, scanty rainfall, poor market facilities, or other equally serious disadvantages. Assistance to settlers should be given only in such measure as will tend to offset the natural difficulties which must be overcome in the settlement of relatively undesirable areas of land. Nothing should be done to attract to the development of new communities people whose sole equipment is a desire to live on the land. Nothing should be done that savors of doing for the man on the land the work that a farmer should do for himself.

There are, however, certain lines along which governments may assist settlers, and in a general way this same assistance may be extended to farmers in any section, new or old.

For the particular aid of settlers governments should insist that information given to the public concerning lands available for settlement is strictly in accordance with the facts. It has become common practice to give to the public misleading information about areas of land available for settlement. The favorable conditions are unduly embellished, and the unfavorable conditions are not made known. Governments, corporate companies, and individuals are culpable in this connection. This misleading information is made the basis for inflated prices for raw lands, and the heavy costs of advertising and of selling organizations are added to the burdens of the settler. In every detail this practice is harmful in the extreme and disastrous to the settler and the community in which he settles. It is within the power of governments to see that the public is not misinformed regarding land-settlement propositions, and material assistance can be given the settler if he is given the facts concerning the lands upon which he proposes to settle.

Governments may, to the advantage of all concerned, determine in advance of the settlement of lands the crops which may be produced there successfully and marketed with profit to the settler. One of the serious disadvantages under which a settler labors is his lack of knowledge of what he should do in his new location in the way of crop production. Experience has shown that in the absence of proper guidance in new locations settlers follow the practices in farming with which they are familiar to the end that they endeavor to produce crops not suited to their location or they produce crops for which they find no ready market. Information in regard to the proper handling of soils and the proper crops to produce is more valuable assistance to a settler than the loan of money or the breaking up of the raw lands for him.

Settlers should be assisted in the formation of organizations and associations for the purpose of furthering their mutual interests. The rapid settlement of a community brings together many people strange to each other; people who have been accustomed to growing different crops, different types of live stock, different business methods, and to different social and educational institutions. Unless some disinterested agency is available and active from the outset in bringing these people together and convincing them that for the good of each and all they must work together, they will drift into disagreement and disadvantageous farming and business methods. The prosperous and generally satisfactory conditions existing in sections where community cooperation is effective is illustrative of the benefits arising from cooperation among farmers. There is no time so satisfactory as the settlement period of a community for organizing the farmers to work along lines to their advantage.

Legislation should be provided which will secure for the farmer the use of borrowed money at rates of interest not in excess of the rates enjoyed by manufacturing and merchandising establishments. No class of producers has been



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so much at the mercy of the money lender as has the farmer. Statistics show that in at least the United States the farmer pays a higher rate of interest on borrowed capital than any other class of borrowers offering real security for loans. There is no good reason for requiring the farmer to pay excessive and inequitable rates of interest, particularly when it is considered that the money borrowed by the farmer is utilized in building up the resources of the country and adding to the revenues thereof. Manufacturing and commerce have made phenomenal growth in the Western Hemisphere through the use of capital at low rates of interest. Agriculture has made equally phenomenal growth during the same period in spite of the burden of excessive rates of interest on borrowed capital. When agriculture, manufacturing, and general commerce are put on even basis as to rates of interest on borrowed capital, agriculture will take its proper place—the most important industry in the Western Hemisphere.

## UNIFORM GRADES AND STANDARD PACKAGES.

By C. T. MORE,

*Investigator in Grades and Standards, United States Department of Agriculture.*

The irrigated sections of the western part of the United States have made wonderful advances both in development and production. This has not all been made possible by the golden opportunities furnished by a new, undeveloped territory, for such a country also furnishes difficulties. To overcome these great faith and perseverance are required on the part of progressive men.

One of the greatest difficulties in our irrigated sections has been that of profitably marketing the farm products. This is a problem in any section, but when the location is hundreds or thousands of miles from the best markets it is a very serious one. The products grown under irrigation are distributed to all parts of the country; it can not be said, however, that a profit is always realized.

Production in these western sections is certain to increase rapidly in the near future and those interested in the growth and distribution of these products are thoughtfully planning for the future.

It is believed that the standardization of their products is absolutely essential and ought possibly to be placed at the head of their marketing program. This is true not only in our irrigated States, but in every producing section.

The question of the standardization of farm products is not a new one, but during recent years growers and shippers have come to realize its need very keenly, and the wholesale and retail trade have shown an ever-increasing and insistent demand for better prepared produce until to-day this is one of the most important phases of our marketing problem.

From the viewpoint of the economist this problem is of vital importance and its solution is worthy of his best endeavors, because the wastes and losses which producers now suffer in marketing perishable products are due to a considerable extent to the poor condition in which they are forwarded to market. Investigators of the so-called high cost of living will find the consumer directly affected by all marketing practices which are not efficient and economical.

In the past little attention has been given to this question, because until comparatively recent years our cities, large and small, depended upon nearby

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producing sections for most of their fruits and produce. Transportation, refrigeration, and other facilities for handling farm products have been gradually developed until now we are not surprised to find Oregon apples on sale in Maine and Florida; New Jersey sweet potatoes in Denver or Seattle; cantaloupes from California, Delaware, Texas, and Michigan offered in Minneapolis on the same day; and Florida new potatoes distributed from the Panama Canal Zone to Alaska.

To-day definite standards are considered an essential basis for satisfactory dealing in most products, and State and national lawmakers are enacting laws providing fixed standards, grades, and markings under which certain products must be prepared for market and are establishing certain standard uniform packages of fixed size and capacity which must be used.

## UNIFORM GRADES.

The subject chosen for this paper deals with two important phases of the broader subject of the standardization of farm products—namely, uniform grades and standard packages. The first benefit derived from uniform grades for any crop is the establishment of a basis on which buyer and seller may deal with mutual understanding and confidence. The next benefit, providing the grading is properly and constantly maintained, should be the elimination of a large part of the usual loss and waste which is constantly encountered in handling ungraded perishable products. It should be remembered that in the end these losses usually are borne by the grower and the consumer.

At present in many sections each grower or each community grades according to local custom or standards, if any are used, and as a result a city dealer buying carloads of produce, such as apples, peaches, potatoes, hay, or grain on the quotations of a distant farmer, local buyer, or shipper, usually has little knowledge of the quality he may expect to receive, so that if he buys from five or six different shippers over a wide territory, he may receive as many grades of a product under as many designations. That is why wholesalers are loath to buy ordinary products from individual shippers except at a price under the market, for they can just as easily purchase from large shippers' or growers' organizations which have a reputation for uniform grading, and thus have no fear as to the quality they will receive, knowing the guarantee of these shippers means a prompt adjustment in case there is a rejection or any question regarding the quality of the product.

The lack of uniform grading is largely responsible for the fact that farmers must send much of their produce to market on a consignment basis. As long as growers insist on shipping a mixed or ungraded product of good, medium, and poor quality all in one package, just so long will their returns on these products be unsatisfactory and probably cause them losses. This is because to a very large extent the quality of the poorer grades contained in each package will determine the selling price of the entire lot, that portion which is of good quality being sacrificed.

That this practice of shipping ungraded produce may become not only unprofitable to the farmer and shipper but detrimental to the health of the consumer, is indicated by recent legislation in the State of Illinois concerning the shipment and sale of eggs. It is a notable fact that many millions of dollars are lost yearly to farmers and consumers because farmers do not handle and care for their eggs intelligently. Many farmers are in the habit of taking all of their eggs to the country dealer without grading them, although they are gathered sometimes over a period of several days or weeks, even in the hot summer months. The dealer in turn ships them ungraded and uncandled to

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the city, with the result that many low-grade and rotten eggs reach the market. Even a rotten egg has its use in the process of tanning, but in the past large quantities have found their way into consumption through unscrupulous dealers and manufacturers. It has been found very difficult to control the traffic in these rotten eggs, so now the State Food Commission of Illinois proposes to stop the shipment of these mixed grades by prosecuting those responsible for the shipment of bad eggs. This will force the farmer and country shipper to candle out the eggs unfit for sale for food. As a result the poultry business probably will receive more of the careful attention which it deserves, a larger percentage of the eggs produced will reach the market in good condition, and the consumer will benefit not only in quality but in price.

I wish to emphasize especially the value of uniform grades as a basis for dealing in perishable products. When uniform grading is not practiced, how can there be any satisfactory basis on which to deal?

The majority of wholesale dealers prefer to buy outright the farm products they handle. Competition in this line of trade is as keen as in most lines and the opportunity for serious losses is much greater because practically all farm products are perishable, and many of them extremely so. Not only is this true, but probably the market for no other line of goods is so quickly and vitally affected by weather conditions. Therefore farm products should reach the wholesaler or retailer in as perfect a merchantable condition as possible for they must be sold quickly.

One of the hardest problems with which shippers have to contend is the rejection or refusal of cars of produce upon arrival on the market. Sometimes, of course, the purchaser of the car is dishonest and is taking advantage of the shipper, but more often the rejection is justified because the condition or quality of the contents of the car does not come up to the specifications or market demands. If the product has been graded under established standards and rules there is a basis on which to arbitrate the claim and the adjustment is simplified, but if it has not been so graded the case is more difficult and the shipper probably will be dissatisfied with his settlement and quite likely will not get as favorable an adjustment as though the produce were shipped under fixed grades.

A large and comparatively new farmers' cooperative marketing organization of the West, composed of a number of local or branch units, found at the end of last season that its progress had been seriously hampered because of losses in shipping and the consequent serious dissatisfaction of its growers. The directors analyzed the situation and found that their lack of uniform and careful grading was mainly responsible. It was at once decided to establish fixed standards and uniform grading rules to be observed by all the local or branch organizations. Each branch will be held responsible for its grading and required to install grading machinery. An inspector will be placed at each local organization to see that the output is kept up to the advertised standards.

In a recent bulletin of the Department of Agriculture,[1] reference is made to the report of an investigator on the Chicago market. He found that, judging from observations made from September 15 to December 5 inclusive and from the statements of large apple dealers, approximately 25 per cent of the car-lot bulk arrivals of apples, equivalent to about 350 carloads, and also 10 per cent of the contents in barreled shipments, equivalent to about 160 carloads, or a total of about 510 carloads of the apples received, were so poor in grade and

[1] Bulletin 802. Apple Market Investigations, 1914–15.

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quality that they would not have brought freight charges had this kind of fruit been received in straight carload quantities. The cost of the barrels, packing, loading, and at least a part if not all the freight charges on this poor fruit might have been saved to the grower had it been graded and these culls left on the farm. The Chicago market undoubtedly would have been relieved, and the well-graded stock would have brought more money and met a more ready sale.

The most rapid development in adopting uniform grades and packages has been made by the growers and shippers of our far Western States. Because of their comparatively sparse population it became necessary, as the output of various farm products increased, to find markets in the Middle West, East, and Southwest. Since this necessitated transportation over long distances at heavy expense it was found unprofitable to ship anything of poor or even ordinary quality to these markets, and so in each locality these western shippers were compelled to standardize and to establish uniformity in their grading and packing systems. The fact that they have been successful in marketing their products all over this country and in building up a heavy export business is proof that they are following right methods.

Believing that still better results could be obtained in marketing their fruit, if all growers, shippers, and growers' marketing associations of the Northwest prepared their fruit for market under one set of uniform grading rules, a conference was held in Spokane during the spring of 1915 to decide upon such rules. This was attended by members of the Northwest Fruit Shippers' Council and by delegates from a large number of growers' organizations. Very complete and comprehensive uniform grading rules were adopted for the grading and packing of practically all fruits grown in the four Northwestern States—Oregon, Washington, Montana, and Idaho.

### STANDARD PACKAGES.

After the crop is satisfactorily graded it must usually be placed in some type of container in order to transport it to the retailer. Uniform, standard packages, therefore, are nearly as essential for satisfactory dealing as are uniform grades.

One can not help being amused when he views a collection of our packages consisting of scores of sizes and types, but many times this question of uniform packages becomes a very serious one. An association of a Middle Western State, which ships small fruits, found itself practically shut out of certain markets upon which it was depending for the sale of a large part of its berries. It was confronted with this situation because the growers of that State desired to use a short box, smaller than the one declared standard by law in the markets in which the trouble arose. Serious losses might easily occur from such complication. Another section was hampered in marketing a crop because one type of shipping container popular in that section could not be shipped beyond the freight classification territory in which it was situated, and several large markets were thus closed to its growers.

Not only does confusion arise from a multiplicity of grades or packages, but an opportunity is thereby presented for manipulation or dishonesty. The Canadian standard berry box has for some time been the four-fifths dry quart. It is reported that some dealers have repacked berries from full dry quart boxes into this four-fifths quart, thus making 30 boxes from one 24-quart crate. Unfortunately similar repacking has been a common practice in our own country under certain circumstances.

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During the past season the Office of Markets and Rural Organization of the United States Department of Agriculture found that its reports of peach movement and prices, gathered and disseminated in connection with its experiments in telegraphic market news were not always clear to peach shippers and dealers in the various sections, because of the large assortment of packages in use, one section not being familiar with the packages used in another. It was necessary to mail out a special circular describing all of these packages, stating their capacity and which were used in each State.

An investigator found cantaloupes quoted in Milwaukee one day last season from various States, packed apparently in 14 different shaped or sized packages. Among the samples of containers collected by the Office of Markets and Rural Organization are six tomato crates (manufactured by six different factories), each of which holds six 4-quart baskets of tomatoes. While these crates are all made for the same purpose and to carry the same number of baskets of the same product, the inside measurements of no two are alike. California and Florida, our two orange-producing States, do not use the same sized box. The hampers used for shipping beans, peas, cucumbers, lettuce, and other truck crops usually are supposed to contain a bushel of 32 quarts, but they are made in sizes ranging from 28 to 29, 30 and 32 quarts. A 1½-bushel hamper is used in at least one large trucking section.

Sometimes "snide" packages have come into use, because of a demand on the part of greedy or dishonest growers for a short package. In other cases manufacturers have started making them with the idea of getting a little advantage over competitors, and increasing sales by showing the farmer how he might pack a greater number of packages from a given quantity of fruit or vegetables by using the package they had to offer.

In a car of mixed fruit loading in the Middle West for Chicago recently I saw apples packed in packages of five different types—in barrels, boxes, bushel baskets, one-third bushel Climax baskets, and bushel hampers. A sixth package, holding two-thirds of a bushel, is also used, which is quite different from these five others.

Compare such mixed shipments, packed under no uniform grades, with a carload of western apples from a growers' cooperative marketing organization, all in one-sized container, packed under uniform grades, each box containing only fruit of one size, rigidly inspected, the package labeled, fully marked with the name of the grower, his address, the name of variety, the grade, and even the exact number of apples in the package. Do you wonder that discriminating buyers, knowing the count and grade and exact cost per unit, prefer to buy such fruit?

Growers, shippers, and package manufacturers are many times hampered by the lack of standardization of packages.

### EFFORTS TO IMPROVE CONDITIONS.

The questions of uniform grades and standard packages are receiving much attention at present. The following national organizations among the wholesale trade which handle all perishable products are agitating the question: The National Poultry, Butter & Egg Association, which is making strenuous efforts to get the shippers and wholesalers dealing in these products to unite on uniform standards and to buy and sell on the grades adopted by this association; The International Apple Shippers' Association, which is especially interested in standardization as it affects the apple business; The National League of Commission Merchants and the Western Fruit Jobbers' Association, both of

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which are backing every effort looking toward standardization. State and National Agricultural Departments are interested, and the railroads are helping through their agricultural and industrial departments.

State legislatures and our National Congress have enacted a number of laws dealing with these subjects, but only a start has been made. The Sulzer apple law, effective July 1, 1913, established a Federal standard barrel for apples and also grades under which apples may be packed and branded. The use of this standard barrel for apples is mandatory, but the use of the grades is not. Growers may grade and pack their apples under this law, and if they pack them in full compliance with it, they may mark the barrels "Standard," showing that barrels and contents are standard in every way. It is believed that growers doing so will find a more profitable market as buyers discriminate in favor of apples so graded.

The Federal standard-barrel act, which becomes effective July 1, 1916, establishes a unit of measure for the United States, for all dry products when handled in barrels, and applies to intrastate as well as interstate trade. This is the first container made a Federal standard package, and it is hoped others will be established soon. This barrel will replace a large number of short-measure packages which are used for potatoes, truck crops, fruits, etc., and which have varying capacities from 2 bushels up to 10 or 11 pecks.

For several years unsuccessful endeavors have been made to standardize the apple box and the small box or cup used for berries and small fruits. These and other packages are practically certain to be standardized in the near future because of the insistent demand.

New York, Maine, Massachusetts, Connecticut, Vermont, and several Western States have laws which are now, or will soon be, in effect standardizing the grading and packing of apples. New York State, unfortunately, has established two sets of standard grape baskets. About 20 States have enacted laws requiring the use of dry-measure quart and pint boxes for berries and other small fruits. Only a few years ago liquid quarts and other short-measure packages were very commonly used, but now very little of this fruit is shipped in other than full-measure packages.

We should have uniform State laws on such subjects, or, better still, national laws, the need of which may be demonstrated by citing the New York apple-packing law, which requires New York apples sold in that State to be plainly marked whether "Fancy grade," "A grade," "B grade," or "Ungraded." Pennsylvania has no such law; therefore a Pennsylvania grower may pack, mark, and sell his best grades in Pennsylvania and then ship his inferior grades unmarked into New York. Is this fair to the New York growers?

I have purposely left until the last a reference to cooperative marketing as one of the most successful methods employed to secure a more uniform grade of farm products properly packed in standard packages. It is found extremely difficult to get the individual grower who markets his own crop to prepare it for market properly. It seems that this should not be true, but either through ignorance of market requirements, carelessness, or a desire to force the market to take what it suits his convenience to ship, the grower himself continually works against his own best interests, many times ruining his markets with wasty, unattractive, unsalable products. By far the larger part of the standardized fruits and vegetables reaching our markets at present are shipped by farmers' cooperative marketing organizations or by strong private firms who have established their reputation on the market by shipping produce packed by themselves rather than depending on the packing of the growers. Although not all cooperative organizations which have been started have been successes,

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I think none has enjoyed a lasting success unless it has been based on the marketing of a standardized product.

A large California organization which markets citrus fruits could not afford to spend $350,000 in 1915 on advertising its fruits if it were not marketing a standardized product. If growers of all sections would profit by the experience of farmers in several localities in Louisiana and Mississippi, their marketing problems would be simplified. These men found they were unable to market their hay profitably because it was not graded and baled as their markets demanded and as northern and western hay was shipped. In numerous cases these farmers are solving their problems by cooperation. After an association is formed, hay graders from such large markets as Birmingham and New Orleans are employed to teach them how to put up their hay in a marketable condition. The State agricultural departments, of course, are aiding them in their efforts to produce crops of the quality demanded.

Nearly all growers are very desirous of securing cash buyers or making f. o. b. sales, but they often find it difficult to do so. Cooperative organizations with a uniformly graded output, however, are usually very successful in making outright sales, and unless they prefer to do so consign little of their output. A southern growers' organization had no difficulty this past spring in selling all cars of the growers' potatoes which were passed by its inspectors. But those cars which were not up to the grade and which the manager could not guarantee, he shipped on consignment rather than sell and risk injuring the reputation of his organization.

Realizing that the prosperity of the growers depends upon eliminating from the market, so far as possible, the undesirable products, or those packed to deceive the public by indifferent or careless growers, efforts are being made in several States to stop the shipping of such fruits and vegetables. California and Florida are endeavoring to have the growers leave their oranges and grapefruit on the trees until such time as the fruit is fit for consumption rather than ship it when immature, which will often prejudice the public against later shipments. In a number of Western States it is unlawful to offer wormy apples for sale. The last California Legislature passed an act to establish a standard for the packing in the State of California of a number of kinds of fresh fruits, and to prevent deception and also to establish a system of inspection.

It is said that after Canada enacted its "fruit marks and fruit packages act" its export apple business was greatly benefited, no doubt at the expense of exports from the United States. Among the other requirements of her law it is specified that the faced or shown surface of a package of fruit must represent within 15 per cent the average contents of the package in such items as quality and size.

The extension of the use of uniform grades and standard packages will probably be gradual. The insistent market demand, the increasing difficulty in marketing unstandardized products profitably and the example set by progressive growers and marketing organizations will all serve as an incentive toward better methods.

It is stated frequently that standardization of farm products is the solution of the marketing problem. While this may be an extreme statement, I believe that a standardized product is more than half sold, and that along with the progress we make in this work we shall surely realize improvement in other phases of the marketing question.

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## STANDARDIZATION OF VEGETABLES.

By S. J. COOK,

*Manager South Shore Growers and Shippers Association, Silver Creek, N. Y.*

The growing and marketing of vegetables on a commercial scale in this country is of prime importance. Very few are aware of the fact that in many States vegetables exceed in value all horticultural products, and the industry is rapidly increasing in importance with the growth of our cities and the development of our lands.

With increased area brought under cultivation and with improved methods of culture, the general trend in the great field of staple vegetables is toward an increased production. Of late years the cultivators of the soil have learned that intelligence, science, and study are no mean factors in the successful cultivation of the soil, and that labor of the hands is most prolific when backed by the careful study of the brain.

For years our agricultural colleges and experiment stations have been teaching the farmer how to produce more and better crops, and that much good has been accomplished along this line is shown by more intelligent methods of production, which has had a tendency to largely increase the yield.

Now, it becomes more apparent each year that a large majority of commercial vegetable growers are depending on increased production to make a profit, for the reason that they do not recognize the great problems relating to the marketing of their crops, and which is quite as important as those relating to production; and to-day the producer, in many instances, realizes that any increase in acreage would result in large overproduction, and however desirable increased production may appear from the growers' standpoint, yet it is not advisable unless such increase encourages consumption. Conditions are changing, producers are realizing that quality is the most important factor in the marketing of their products, and that while the situation at times has appeared to many as one of overproduction, because of the large quantities of poorly assorted produce dumped on our markets, yet it must be admitted that in the past quality has not shown the care in connection with increased production and that lack of thorough, accurate knowledge of how to properly grade and pack produce for market is costing the producers of this country thousands of dollars daily. These facts are brought home each year, yet the average grower is slow to appreciate the fact that the consuming public demands quality rather than quantity.

### STANDARDIZING ABSOLUTELY NECESSARY FOR BEST RESULTS.

One of the greatest problems confronting the producer of perishable products to-day is the standardizing of his products, and no subject is of greater importance than that of better grading and packing; no field offers greater possibilities, and while proper distribution is a factor of great importance and is considered as one of the very serious problems which presents itself to this generation, yet I consider the standardization of our products more important, as it is the base for the establishment of a system of cooperative selling, for no cooperative organization can inaugurate a successful system of cooperative selling unless they can maintain uniform grade and pack.

A study of the successful cooperative selling organizations of this country show that success is largely due to the untiring efforts put forth to educate the members to produce high-quality products which, coupled with systematic

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grade and pack, have made possible uniformity. The advantages in the sale of a uniform grade and pack are now known to many who have achieved success.

FUNDAMENTAL PRINCIPLES OF STANDARDIZATION.

The subject of standardization of vegetables is one so broad that I undertake to present but a crude analysis.

The widely scattered areas of production, coupled with the varied soil and diversity of temperature and many different practices of culture which have to do with different sections of our country, make it impossible for one to even suggest a plan that would be practical to meet all conditions, even in his own State. At the present time there is a great variation in practices, not only in the matter of grade and pack but also in the different kinds and styles of packages, so I have taken New York State as a base for my remarks. Vegetable crops grown in New York State show a variety; in fact, all vegetables of economic importance are produced in this State.

*Vegetable growers' associations.*—The Empire State has several small and a few large vegetable associations. All of these associations were organized for the purpose of marketing vegetables. There are at least three systems of packing and grading.

First. Packing and grading by the grower, inspection being done at the car by the association's loader, who issues a slip to the grower for the delivery of a certain number of packages. This system is very lax, as it permits the grower to pack almost everything grown, regardless of size and quality, and generally terminates in a flat failure, as it is impossible to make satisfactory sales of poorly assorted produce; besides it is an incentive for growers to pack poor, unmarketable produce and make the other fellow's better grade help sell it. Some growers can not pack quality, for they do not produce it.

Second. Packing and grading by the grower with a more rigid system of inspection. This system was tried out by our association in the packing and sale of tomatoes, that the grower might have the best of understanding as to what constituted quality grade and pack. We conceived the plan of holding field meetings, at which time expert packers demonstrated proper grading and packing. We also furnished each grower with a rubber stamp number, same being registered with grower's name in the office. The object of the stamp was to make each grower's pack stand on its own merits, and in case of any irregular packing or complaint on the part of the consignee the grower's number would identify him and he would personally be asked to stand any loss or reduction that might be made on same, while the balance of the car would be pooled. This system has saved the honest grower many dollars and has put the blame where it rightly belonged. It has exposed many dishonest growers, who placed rubbish, stones, or any inferior off-grade product in the bottoms of containers and then faced baskets with No. 1 quality. We have found this system quite satisfactory in many ways, but still there is a lack of uniformity in grade and pack.

Third. Packing and grading by the association. The produce is carefully harvested by the grower and delivered to the packing house or shed. For illustration we will take the tomato. In harvesting tomatoes for market one should handle them very carefully. They should be stemmed when picked; never drop or throw them into baskets. We use 20-pound climax baskets for shipping. These are taken to the field and are used only once for picking. When filled they are drawn to the packing house and placed on benches which are constructed for this purpose. They are then packed in the same style basket, which saves dumping them on benches, which has a tendency to bruise them. Packers remove

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any stems that may have been left by the pickers; carefully wipe each tomato, and pack three layers in a basket, all cracked and inferior ones are thrown out; a properly packed basket should be well filled, and when packed are level full, top layer being faced. Where several packers are at work an attendant places the unpacked baskets on benches, removing and covering the packed ones. For long-distance shipment tomatoes should be harvested well on green. It is important in packing quality tomatoes to have all a like degree of ripeness; therefore it is necessary that the best of judgment be exercised in the proper harvesting, and if there is neglect in failing to harvest tomatoes when they are of a proper degree of ripeness much loss will be caused by many of them becoming too ripe. We have successfully shipped tomatoes to many distant markets, particularly throughout the Southern States during the months of September and early October. At times our fruit has been in competition with shipments from California. There are few, if any, vegetables that give any better returns for painstaking effort and honest grade and pack than the tomato. Being of high perishable nature, it is liable to many defects, and the highest efficiency in proper grading and packing can only be secured by training employees to the knowledge that it is absolutely necessary to pack an article better than the ordinary.

Now, what has been said in regard to tomatoes holds true with other perishable products.

*Essential factors in the undertaking.*—There are certain underlying principles that have to do with success in the standardization of vegetables. First, let us analyze the word "standardization." It is to conform to a certain standard. This is the fundamental factor underlying the first requirements and is the base, for without uniformity it will be impossible to standardize any product.

Now, in the production of a high-grade product, I mention a few of the important factors which will very greatly determine the market value, flavor, texture, form, size, color, shipping and keeping qualities. Flavor and texture enter largely into the matter of palatability, while the others mentioned influence the appetizing property.

The word quality in vegetables may be used to cover a variety of characteristics, which often determine the market value of a product. In defining grades for certain vegetables all of the above should be taken into consideration. Our aim should be to produce quality rather than quantity, for it is physically impossible to pack a quality product, however good the methods of the packer, however careful his sorting devices, if the original article is not of substantial good character and the kind that will tend to increase consumption. The future prosperity of the vegetable industry depends on quality products properly grown, properly assorted, graded and packed. This, coupled with intelligent distribution will accomplish the results so much needed.

*Packages.*—The package is an important factor in standardization. In selecting a package to meet our purpose we should consider first that it is durable, so that it will protect the contents. The next in importance is the appearance; it should be as attractive as possible. Neatness, lightness, and uniformity is desirable. Its appearance should create favorable impression and attract the buyer's attention. It should be so constructed as to present the contents attractively.

There is a growing tendency among the more progressive vegetable producers to offer their products in standard packages. There is, however, a great need for improvement, and I look forward in the near future to some sweeping reform in regard to certain packages. To-day we have packages in endless number of varied descriptions. Many of them have, undoubtedly, been adopted to meet the requirements of certain markets, and all represent different ideas of

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growers and manufacturers. The many different containers in use, carrying the same products, have, in the past, greatly affected market conditions. For illustration, we find in New York State a large growers' organization which markets their high quality head lettuce in boxes. The box used is 16 inches wide, 28 inches long, and 8¼ inches deep. This holds 2 dozen No. 1 lettuce, while they market their No. 2 or 3 grade in half-barrel hampers.

In another county in the same State we find another large growers' organization who market their No. 1 lettuce in the regular half-barrel hampers and use the standard boxes mentioned to market their second grade; and while the trade-mark or label of each association would probably designate the proper brand, yet there is great diversity of quality represented in the same style package, which is more or less confusing to the trade and may result in many misunderstandings, besides affording an opportunity for dishonesty. That there are great opportunities for the improvement in the standardizing of packages is admitted by many who are interested in the production and sale of produce.

PRESENT METHODS OF GRADING AND PACKING SHOULD BE REVISED AND CORRECTED.

Too many growers have the idea that if they can get their produce inside a car door and procure a receipt for it that some one is stuck to make good. Such unbusinesslike action on the part of growers has much to do with the low prices. Many growers do not appreciate the fact that their goods are in direct competition with shipments from other parts of the country. Their idea of quality is an imagination of their own, and shows a great need of educational work along this line.

Growers and shippers in the past have resorted to many dishonest practices—in filling bottoms of containers with poor, unmarketable, small, scabby potatoes and apples and topping off with two or three loads of well-graded stock. I could relate a number of such instances of many different vegetables, which I have personally inspected, that were packed dishonestly and with but one thought—to deceive the purchaser. Many acute cases of rejected shipments are the outcome of such practices. Other causes for rejections are many—rough handling at points of origin in loading bulk potatoes, cabbage, apples, etc., which greatly injures the keeping qualities as well as the appearance of the produce. All this carelessness shows lack of good business judgment on the part of the shipper; also this low-quality product is sure to return the shipper the lowest possible price, and it frequently occurs that such shipments are sold for freight charges.

Every year furnishes many illustrations like the above, and it is almost a daily occurence in our large distributing centers. Rejected shipments of poor, ungraded products are, in a large measure, to blame for glutted markets and very greatly affect the selling price of better grades of standardized products.

Easy marketing has made it possible for growers to ship everything grown on the farm regardless of size, grade, or quality. The average grower will not take time to properly grade and pack his products if he can dispose of it without doing so, and just as long as it is made possible for him to do so we will, at times, see a large oversupply of poor, unmarketable produce offered for sale.

For illustration, the New York State apple law furnishes plenty of evidence as to what might be accomplished by legislation. Before this law was enacted there were many dishonest practices, apples marked "No. 1 or A grade" many times consisted of a variety of culls. second grade, and a few well-grown specimens for facing.

We now have a law that provides that every closed package containing apples grown in the State, which are packed, sold, and distributed, shall bear upon the

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outside of one end in plain letters and figures the name and address of the packer, the true name of the variety, grade, or class. It is unlawful for any person within the State to pack, sell, or distribute apples which are adulterated or misbranded, and the law further provides penalties for violation.

This law has accomplished a much-needed reform. Being compulsory, growers are obliged to properly pack and grade their apples to meet the requirements of the law. It has created a new era of apple industry, for it furnishes a basis for honest trading, which makes possible the purchase and sale without rigid inspection. The law provides classification governing grades and defines variety, color, shape, disease, insect, and fungus injury.

Now, I believe it would be of great benefit to the growers, receivers, commission merchants, and consumers if there were laws enacted governing grades and containers. Our vegetable products are of a perishable nature and deteriorate rapidly, it is, therefore, necessary that they should be handled with the quickest dispatch possible. There is constant market fluctuation in price, according to receipts and demand, which makes the business speculative and on account of the perishable nature of the products, sales are made hastily and without consideration of possible legal points involved. Verbal agreements must often suffice; therefore great dependence must be placed on the honesty of the seller regarding quality, grade, and pack, and it is of the utmost importance that those handling perishable commodities, whether grower, shipper, receiver, commission merchant, or broker, have an accurate knowledge of the produce which is offered for sale.

Many aggravated cases of rejected shipments are the outcome of misunderstandings in regard to different ideas of quality on the part of the shipper and buyer and I believe that many of the troubles and misunderstandings are a lack of accuracy on the part of the shipper in describing goods offered and I am an advocate of some uniform system which would define certain standards for vegetables. I do not wish to be understood as saying that classifications governing grade and pack will eliminate all the troubles, such as improper distribution, or will it relieve the situation in years of over production, but what I do wish to claim for such a system is that it would furnish a better understanding and rule of fairness which would, in a large measure, eliminate disputes, thereby preventing many rejections.

### ORGANIZATION NEEDED.

Just a word regarding common need. In order to get the best possible results in grading, packing, and marketing, the vegetable growers should organize cooperative associations and should establish sorting, grading, and packing stations. They should begin at the bottom by making a careful study of their conditions and acquire all knowledge possible, both from a scientific and business standpoint, of all the terms and principles that enter into the growing, harvesting, and merchandising of their products and their slogan should be quality rather than quantity.

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## JOINT SESSION OF SUBSECTION 1 OF SECTION III AND SUBSECTION 1 OF SECTION VII.[1]

RALEIGH HOTEL,
*Friday afternoon, December 31, 1915.*

Chairman, JAMES F. CALLBREATH.

Papers presented:

Mine Accidents and Uniform Records, by Albert H. Fay.

Uniformity in Collection of Statistics of Mineral Production, by Edward W. Parker.

Improved Mining and Metallurgical Methods as an Aid to Conservation, by L. D. Ricketts.

[1] The papers and report of this session are found in Vol. VIII of the Proceedings of the Second Pan-American Scientific Congress.



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## GENERAL SESSION OF SECTION III.[1]

RALEIGH HOTEL,
*Monday morning, January 3, 1916.*

Chairman, HENRY S. GRAVES.

The session was called to order at 9 o'clock by the chairman.

Papers presented:

Contribución a la exploración forestal de la Patagonia Austral, by Cristóbal M. Hicken.

South American forest resources and their relation to the world's timber supply, by Raphael Zon.

The lesson of forestry in the Philippine Islands, by Maj. George P. Ahern.

### CONTRIBUCIÓN A LA EXPLORACIÓN FORESTAL EN LA PATAGONIA AUSTRAL.

Por CRISTÓBAL M. HICKEN,

*Profesor de Botánica en la Universidad Nacional de Buenos Aires, Argentina.*

I.

La presencia de bosques extensos en la parte andina de la Patagonia austral, desde los 37° sur más o menos, hasta las últimas islas del continente sudamericano fué señalada desde siglos atrás por todos los que recorrieron esas zonas en busca de tesoros minerales o en son de dominios políticos; pero la belleza de esos bosques atrajo menos al turista que al hombre de ciencia, pues mientras la dificultad de su acceso alejaba al primero, la misma atraía suavemente al segundo, que esperaba hallar en las sorpresas de las regiones ignoradas, satisfacción amplia que le resarciera de las fatigas experimentadas.

Y así conocemos hoy botánicamente con bastante aproximación las riquezas florales de esas comarcas, aun cuando sus bellezas nos sean totalmente desconocidas, y los catálogos imperfectos y esto en muy pocos puntos de esa extendida zona, han sido sin embargo suficientes para que la Argentina se interesara por ellos y los hiciera estudiar desde el punto de vista de su aplicación y explotación.

Sin pretender hacer una historia detallada de las diferentes tentativas efectuadas en ese sentido, ni mencionar a todos los que consagraron sus esfuerzos para utilizar esa riqueza nacional, no quiero pasar por alto en estos momentos los nombres de Bailey Willis, de Max Rothkugel y de Curran, hijos

[1] There was no stenographic report of this meeting.



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de los Estados Unidos quienes contratados por el gobierno argentino, hicieron los primeros estudios de mensura y levantamiento forestal con miras puramente de índole aplicado-económico-prácticas.

Sus trabajos nos dan idea ya muy aproximada de las condiciones harto ventajosas en que se pueden utilizar las maderas de esas zonas y conservar indefinidamente y aun mejorar esa fuente de bienestar humano.

Mis condiciones de botánico sistemático y no de técnico o industrial me impiden ofrecer datos de esta última índole o referencias que interesaran más directamente a esta sección del Congreso; pero como soy un convencido de que ningún estudio científico, ha de dejar de tener alguna aplicación más o menos inmediata, he creído que las breves referencias que deseo exponer han de contener el *minimum* de interés necesario para merecer de esta asamblea una benévola atención.

## II.

Cuando el 11 de marzo de 1913 fué creada la "Comisión de la Flora Argentina" una de mis primeras tareas como miembro de ella fué la de reconocer o hacer reconocer las zonas aun inexploradas de la Argentina. Quizás llame Vuestra atención que en estos años en que el centro de África ha dejado de tener misterios, en que las regiones del Tibet dejaron de ser sagradas y en que hasta los helados polos de la tierra llegaron a sentir el calor del esfuerzo humano, quizás, digo, llame la atención que aun pueda hablar de zonas inexploradas en la Argentina y esto, en regiones próximas a establecimientos donde la actividad del hombre se deja sentir en todo su vigor.

Y sin embargo ello es así.

Una ojeada rápida sobre el último mapa catastral de Chile comprueba mi aserción y esa zona no es pequeña; se extiende más o menos desde los grados 45° a 50°, es decir, en una longitud de 500 kilómetros por un ancho variado de 30 á 80 kilómetros. Mientras en ese mapa se la designa con el nombre de "regiones desconocidas" en otras se indica como ocupada por inmensos glaciares unidos y confluyentes constituyendo lo que los alemanes llaman "innlandeis"; pero debo confesar que no existe referencia auténtica alguna que sirva de base a esa designación.

Las fracasadas tentativas de Nordenskjöld en 1896, la de Fuentes en 1897, la de Steffen en 1898, las de Hauthal en 1899 y la de Quensel en 1908 para cruzarla, no aportaron ningún dato positivo referente a esas comarcas a las que se seguían atribuyendo un paisaje groenlándico.

En 1903 concebí la idea de recorrerlas, y en 1904 hice algunas investigaciones preliminares en la región de "Seno de la Última Esperanza" avanzando hasta el glacier "Balmaceda," para ver si mis fuerzas podían alcanzar el deseo anhelado. Pasaron los años y en 1913 alentado por el Dr. Reichert presenté a la "Comisión de la Flora" el proyecto de reconocer, con la ayuda de este último señor, esa misteriosa zona.

Pasando por alto todas las peripecias por que tuvo que atravesar la expedición y que en parte están consignadas en mi folleto "Un Viaje al Lago Argentino" publicado en 1915, diré simplemente los resultados de esa nueva tentativa, que si bien no ha pasado de eso, ha aportado positivo material y referencias suficientes para dar una idea asaz clara de esa zona desconocida.

Salidos de las orillas del "Lago Argentino," emprendimos el viaje atravesando el bosque y prefiriendo la orilla del ventisquero y sus morenas como camino más fácil para avanzar con rapidez. Aun así se emplearon tres días en llegar al límite o zona que según nosotros, sugestionados por las *cartas* debía ser el principio del "innlandeis" o llanura groenlándica. Pero aquí

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nuestra sorpresa fué grande: No era un llano de nieve muerto por el frío que se extendía ante nosotros; una sucesión de valles y cerros y de cerros encadenados en montañas con sus cumbres congeladas es cierto y con nieve en sus quebradas, que se unían en grandiosos ventisqueros; pero con flancos arbolados y con valles boscosos y praderas sonrientes donde tumultuosas corrían las aguas a perderse por tierras desconocidas hacia los *fjords* del Pacífico. Esta sorpresa, que me autoriza para negar ahora en absoluto el concepto que se tenía de esa zona, pero que no me permite describirla con exactitud, me sugirió la idea de extender la exploración á toda esa parte y motivó la redacción de un proyecto en colaboración con el Dr. Reichert, que presentado a la consideración de hombres entusiastas y de sociedades científicas, mereció en general la platónica aprobación; y digo en general porque sólo la "Sociedad Científica Alemana de Buenos Aires" prometió un apoyo eficaz que gracias a él, puedo creer muy fundadamente que en estos momentos en que estoy leyendo estas líneas mis esforzados compañeros estarán trepando por las empinadas crestas de esa zona.

III.

Los *Nothofagus antarctica* y *pumilio* son las especies forestales más abundantes a las que a veces se junta el *betuloides*. En las partes bajas aparece el *Drymis Winteri* que alcanza alturas considerables. El bosque es bastante limpio, no hay lianas ni la *Chusquea* que tanto abunda en los bosques del norte y las matas o *Unterholz* son escasas limitándose abajo a la *Fuchsia Macrostemma*, *Embothrium*, *Ribes*, *Escallonia* sobre todo donde el sol puede iluminar con cierta fuerza, por eso abundan al borde de los bosques pues en el resto donde la obscuridad es mayor las únicas leñosas de cierta consideración son el *Maytenus* y *Rhacoma*. No hay epifitas fuera de la *Usnea Barbata*, ni más parásitas vasculares que las graciosas especies de *Myzodendron;* por otra parte estos bosques no difieren de los descritos por Dusen y Skottsberg y sus obras pueden ser consultadas con todo fruto.

Mi trabajo se limita por eso a llamar la atención a que esos bosques ya conocidos en sus esencias y aspectos se extienden a zonas que eran consideradas como *desiertas*, *inhabitables*, *inexplotables* e *incomunicables* y vengo a desvanecer esa idea para que, alentados en la empresa de esa exploración, podamos bien pronto ofrecer un mapa geográfico-botánico, que permita apreciar las mejores condiciones para explotar esas riquezas, y contribuir con ella en alguna forma a mejorar el bienestar humano, único objeto y única finalidad de toda nuestra ciencia.

## SOUTH AMERICAN FOREST RESOURCES AND THEIR RELATION TO THE WORLD'S TIMBER SUPPLY.

By RAPHAEL ZON,

*Chief of Forest Investigations, Forest Service, United States Department of Agriculture.*

The forest resources of South America are very great, but just how great no one at present can know, for vast areas known to be forested are as yet entirely unexplored. Any estimates must necessarily, therefore, be in the nature of very rough approximations, which later explorations and surveys may entirely upset. On the basis of the information now available, the total



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forest area of South America may be placed in the neighborhood of 3,000,000 square miles (7,787,000 square kilometers), or 1,924,000,000 acres. By countries this area may be distributed roughly as follows:

TABLE I.—*Forest areas of South America, by countries (general table).*

| Country. | Forest area. | Acres (millions). | Forest area per 100 inhabitants. | Forest area in per cent of total land area. |
|---|---|---|---|---|
| | *Square miles.* | | *Square miles.* | |
| Argentine | 231,000 | 147 | 3 | 20 |
| Brazil | 1,500,000 | 988 | 9 | 48 |
| Bolivia | 284,000 | 181 | 12 | 55 |
| Chile | 59,000 | 38 | 15 | 15 |
| Colombia | 240,230 | 155 | 5 | 55 |
| Ecuador | 145,000 | 93 | 10 | 67 |
| Guiana | 64,000 | 40 | 3 | 20 |
| Paraguay | 84,000 | 54 | 10 | 30 |
| Peru | 175,000 | 112 | 10 | 25 |
| Uruguay[1] | | | | |
| Venezuela | 180,000 | 116 | 7 | 45 |
| Total | 2,992,230 | 1,924 | 8 | 38 |

[1] No forests of commercial importance.

The commercial value of these vast forests is still known very little. Botanically, the South American forests, particularly those near the Equator and along the river bottoms, consist of a large number of species. "On a single acre it is hardly possible to find two or three trees of the same kind." This botanical wealth of species can not be used as a measure, however, of commercial value. The reasons for the widespread use of wood are its lightness combined with strength, and the ease with which it can be worked. It is these qualities that make wood almost indispensable to our civilization. What is demanded, especially in the international markets, is a light, strong, easily workable timber which can be supplied in large quantities and delivered at a low price. Such timber has so far been supplied by the northern coniferous and temperate hardwood forests of Europe and North America. The richest forests in the world commercially, those of northern Russia and Sweden, botanically are very poor. They consist of only two species—the Scotch pine and the spruce.

If South American tropical forests contain only a few commercially useful kinds of trees which are scattered among a large number of other species of low or no present commercial value at all, the high cost of logging them may make the exploitation of such forests unprofitable. As a matter of fact this has been exactly the case with nearly all of the tropical forests until recently. The few trees known at present as commercially valuable are invariably found scattered among a great many unutilizable ones. In order to cut and remove the valuable species it is necessary, therefore, to cut and leave a good deal of useless material. A more intimate study of the physical properties of tropical woods by the United States forests in the Philippines has shown, however, within recent years that the forests of the Philippine Islands and the Malay Archipelago contain a vast group of trees (*Dipterocarpa*), which, although they are hardwoods, possess many of the qualities of the common woods used in international trade—namely, lightness, strength, and softness. The presence of a large number of utilizable woods in the tropical forests, in addition to

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the rare woods, such as dyewoods, rosewood, mahogany, and others, would place them on an entirely new commercial basis, since they would contribute to the future supply of common hardwood timber for the world.

If further studies show that the forests of South America contain, in addition to the rare dyewoods, quebracho, greenheart, mahogany, etc., a large number of utilizable hardwoods similar to cedro, which is already being exported from there, the economic importance of the South American forests will be great. Our present knowledge of the technical properties of the woods of the South American forests is very inadequate. From what we do know at present, however, there are only three species which, because of their technical properties, may furnish woods suitable for wide use. These are the Parana pine (*Araucaria brasiliensis*) and Chilean pine (*Araucaria imbricata*), two coniferous species, and the Spanish cedar, or cedro (Cedrela, several species), which is a soft hardwood. Most of the other hardwoods known at present are exceedingly hard and heavy and, therefore, difficult to saw. How hard they are may be judged from the fact that sawmill machinery manufactured in the United States, especially for sawing hardwoods in South America, and guaranteed in advance to cut 20,000 feet of hardwoods daily, has, in innumerable tests, developed a maximum capacity of only 7,500 feet a day.

The following is an attempt to estimate very roughly the areas occupied by the different classes of South American woods, and on the basis of these estimates to outline the possible economic importance of the South American forest wealth. The total forest area of 1,924,000,000 acres may be divided into distinct forest regions according to the prevailing commercial species: (I) The coniferous forest, comprising (1) stands of nearly pure Parana pine, and (2) stands of Chilean pine, mixed with some larch, cedar, and South American beech, which may be designated as the Antarctic beech region; (II) the vast hardwood forest, which comprises (3) the tropical hardwood forest in which Spanish cedar is invariably present, and (4) the forest of subtropical hardwoods; (5) stands in which quebracho forms the important species; and (6) stands in which greenheart predominates.

1. The Parana pine-forest region[1] occupies an area of approximately 309,000 square miles or 200,000,000 acres (802,000 square kilometers), the greatest part in the southeastern portion of Brazil in the States of Rio Grande do Sol, Santa Catherina, Parana, São Paulo, southern Minas Geraes, and Matto Grosso. The range of this pine is between the parallel of 18° and 32° S. It derives its name from the State of Parana in Brazil, where it is most plentiful and is commercially the most important tree. In Parana one company alone owns a solid forest, much of which is still in the primitive state, aggregating 3,000,000,000 feet and averaging over 4,000 feet to the acre. Some stands of Parana pine contain as much as 15,000 or 20,000 board-feet to the acre.

2. The Antarctic beech region[2] is the only other region in which conifers are found, such as Chilean pine, larch, and cedar. The Chilean pine is botanically very close to the Parana pine. This region lies chiefly on the slopes of the Andes and is occupying in all an area of approximately 96,000 square miles (61,000,000 acres—248,000 square kilometers).

[1] R. E. Simmons: Lumber Markets of the East Coast of South America, Bur. of Foreign and Domestic Commerce Special Agents Series No. 112, Washington, 1916. [Information with regard to the rest of the continent is to be found in the same writer's "Lumber Markets of the West and North Coasts of South America" in the same series, No. 117.

[2] Bailey Willis: Northern Patagonia, Vol. 1 and atlas. Published for the Ministry of Public Works, Argentine Republic, by Charles Scribner's Sons, New York, 1914.

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3. The tropical and subtropical hardwoods[1] occupy by far the largest areas. The tropical hardwoods are found over an area of some 1,500,000 square miles (more than 1,000,000,000 acres), and the subtropical hardwoods over an area of 259,000 square miles (165,000,000 acres). The most valuable tree of the tropical hardwood forest is the cedro. Cedro (Cedrela odorata and other species) constitutes one of Brazil's most important export hardwoods, and is commonly known in the United States as Spanish cedar. This species does not form pure forests over large areas, but is found scattered among the tropical hardwoods throughout Brazil from the Amazon to the Parana River. The largest and highest grades of logs are cut from the forests in the State of Sao Paulo and in the territory lying south and immediately west of it. In this portion of Brazil the wood is in high favor commercially and is consumed in large quantities. Its softness, the ease with which it can be worked, its ability to hold paint and take a polish, as well as its high grade, commend it for many special uses and make it first in economical importance of all the Brazilian hardwoods. It enters aggressively into competition with the imported pines and in certain markets is preferred for a number of uses. In Brazil it is being cut annually at the rate of about 47,000,000 board-feet. Its range coincides practically with that of the tropical hardwoods. Of the vast variety of other hardwoods which are found in mixture with cedar, perobas, and acapu (*Vouacapoua americana*) are the two species which may be considered among the chief woods for export from the Amazon Valley to the European markets. At any rate, these species more than any other hardwoods, meet locally the need for hardwoods, and, therefore, make unnecessary the importation of American and European hardwood lumber.

4. The hardwoods in which quebracho[2] forms the commercially important species are found chiefly in northern Argentina in the provinces of Tucuman, Santiago del Estero, and Santa Fe, the territories of Formosa and the Chaco, and in the Chaco of Paraguay. Botanically, however, quebracho is distributed over a much larger area. The total possible yield from the forest areas where quebracho occurs in commercial quantities is estimated at 168,000,000 tons, while the present yearly consumption of the wood for all purposes is a little less than 1,000,000 tons. Since the average yield per acre is approximately two tons of the wood, the total forest area in which quebracho occurs in commercial quantities is about 84,000,000 acres. The small yield per acre makes it necessary to cut over about 500,000 acres annually in order to secure 1,000,000 tons of wood which is in demand. Quebracho wood is one of the principal commercial products of South America, its main value being for tanning extract and crossties.

5. Greenheart (*Nectanda rodioci*),[3] with which is associated mora (*Dimorphandra mora*), is the most important tree of British Guiana, the only place where it is being cut extensively. There it is found most abundantly along the Essequibo, Demerara, and Berbice Rivers. Greenheart grows along the seacoast and watercourses, seldom extending more than 50 miles inland and never more than 100 miles. It reaches its best development in a strip of country between 2 and 3 miles wide immediately behind the alluvial deposit which fringes the seacoast. The present export of timber from British Guiana is in the neighbor-

[1] Theodore Roosevelt: Through the Brasilian Wilderness, Scribner, New York, 1914. Raphael Zon: The Forest Resources of the World, Forest Service Bulletin 88, U. S. Dept. of Agriculture, 1910.

[2] C. D. Mell: Quebracho Wood and its Substitutes, Forest Service Circular 202, U. S. Dept. of Agriculture, Washington, 1912.

[3] C. W. Anderson: Forests of British Guiana: General Report on the Forests of the Easily Accessible Districts of the Colony. Dept. of Lands and Mines, Georgetown, Demerara, 1912.

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hood of 200,000 cubic feet, which on a whole is smaller than it was in the past, when at certain years as much as 400,000 cubic feet were exported. Greenheart is chiefly used in ship and dock building because of its immunity against the ravages of the teredo. It is found over a range of over 240,000 square miles, or about 155,000,000 acres (625,000 square kilometers).

The following tables (Tables II and III) show in detail the different forest areas and their location:

TABLE II.—*Forest areas of South Amreica.*

| | Square miles. | Acres (millions). | Square kilometers. |
|---|---|---|---|
| Tropical hardwoods | 1,613,000 | 1,032 | 4,177,805 |
| Parana pine | 309,000 | 200 | 801,611 |
| Subtropical hardwoods | 259,000 | 165 | 670,761 |
| Greenheart-mora forest | 241,000 | 154 | 624,785 |
| Mahogany forest | 84,000 | 54 | 218,672 |
| Quebracho forest | 404,000 | 258 | 1,045,627 |
| Chilean pine-beech forest | 96,000 | 61 | 247,557 |
| Total | 3,006,000 | 1,924 | 7,786,818 |

TABLE III.—*Forest areas of South America, by countries (detailed table).*

| | Per cent of total forest area. | Acres, millions. | Square kilometers. | Area per 100 inhabitants, square kilometers. |
|---|---|---|---|---|
| **Argentina:** | | | | |
| Chilean pine-beech-cedar forest | 15.8 | 23 | 94,307 | ..... |
| Subtropical hardwoods | 2.9 | 4 | 17,682 | ..... |
| Quebracho forest | 81.3 | 120 | 485,681 | ..... |
| Total forest area | 100.0 | 147 | 597,670 | 8.0 |
| **Bolivia:** | | | | |
| Tropical hardwoods | 51.2 | 93 | 376,050 | ..... |
| Subtropical hardwoods | 17.7 | 32 | 129,672 | ..... |
| Quebracho forest | 31.1 | 56 | 228,693 | ..... |
| Total forest area | 100.0 | 181 | 734,415 | 29.1 |
| **Brazil:** | | | | |
| Tropical hardwoods | 77.1 | 760 | 3,076,769 | ..... |
| Parana pine forest | 20.1 | 198 | 801,611 | ..... |
| Quebracho | 2.8 | 28 | 113,169 | ..... |
| Total forest area | 100.0 | 986 | 3,991,549 | 23.0 |
| **Chile:** | | | | |
| Chilean pine-beech-cedar forest | 100.0 | 38 | 153,250 | 4.4 |
| **Colombia:** | | | | |
| Greenheart-mora forest | 5.7 | 9 | 35,365 | ..... |
| Mahogany forest | 26.4 | 41 | 165,037 | ..... |
| Subtropical hardwoods | 39.6 | 61 | 247,557 | ..... |
| Tropical hardwoods | 28.3 | 44 | 176,826 | ..... |
| Total forest area | 100.0 | 155 | 624,785 | 12.3 |
| **Ecuador:** | | | | |
| Tropical hardwoods | 64.2 | 60 | 241,662 | ..... |
| Subtropical hardwoods | 22.6 | 21 | 84,878 | ..... |
| Mahogany forest | 13.2 | 12 | 49,510 | ..... |
| Total forest area | 100.0 | 93 | 376,050 | 25.1 |

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TABLE III.—*Forest areas of South America, by countries (detailed table)*—Continued.

| | Per cent of total forest area. | Acres millions. | Square kilometers. | Area per 100 inhabitants, square kilometers. |
|---|---|---|---|---|
| Guiana: | | | | |
| Greenheart-mora forest | 89.3 | 36 | 147,354 | ..... |
| Tropical hardwoods | 10.7 | 4 | 17,682 | ..... |
| Total forest area | 100.0 | 40 | 165,036 | 7.2 |
| Paraguay: | | | | |
| Quebracho forest | 100.0 | 54 | 218,084 | 25.7 |
| Peru: | | | | |
| Tropical hardwoods | 63.3 | 71 | 288,816 | ..... |
| Subtropical hardwoods | 36.7 | 41 | 167,395 | ..... |
| Total forest area | 100.0 | 112 | 456,211 | ..... |
| Uruguay: | | | | |
| No forests of commercial importance, the whole country being essentially an extension of the great Argentine plain. | | | | |
| Venezuela: | | | | |
| Greenheart-mora forest | 94.1 | 109 | 442,066 | ..... |
| Subtropical hardwoods | 5.0 | 6 | 23,577 | ..... |
| Mahogany forest | .9 | 1 | 4,125 | ..... |
| Total forest area | 100.0 | 116 | 469,768 | 17.0 |

TABLE IV.—*Import and export lumber trade of South America, 1912.*[1]

(Values in dollars, United States currency.)

IMPORTS.

| | Furniture. | Pine, unplaned. | Wood. | | Rosin. | Pine blocks and boards. |
|---|---|---|---|---|---|---|
| | | | Unmanufactured. | Manufactured. | | |
| Argentina | 2,668,280 | 13,964,340 | ..... | ..... | ..... | ..... |
| Bolivia | 130,702 | ..... | 248,087 | 75,794 | ..... | ..... |
| Brasil | 571,002 | ..... | ..... | ..... | 1,593,017 | 2,768,805 |
| Chile | ..... | 1,331,773 | ..... | ..... | ..... | ..... |
| Paraguay | [2] 4,835 | ..... | ..... | ..... | ..... | ..... |
| Peru | [3] 171,631 | ..... | ..... | ..... | ..... | ..... |
| Uruguay | [3] 268,841 | ..... | ..... | ..... | ..... | ..... |
| Total | 4,105,241 | 15,316,113 | 248,087 | 75,794 | 1,593,017 | 2,768,805 |

| | Staves and hoops. | Rough, sawed, planed, and veneered. | Lumber and woods. | Turpentine. | Matches. | Total lumber. | Naval stores. |
|---|---|---|---|---|---|---|---|
| Argentina | ..... | ..... | ..... | ..... | ..... | 16,652,570 | ..... |
| Bolivia | ..... | ..... | ..... | ..... | ..... | 454,583 | ..... |
| Brasil | 186,883 | 464,835 | ..... | ..... | ..... | 4,291,525 | 1,593,017 |
| Chile | ..... | ..... | ..... | ..... | ..... | 1,331,773 | ..... |
| Colombia | ..... | ..... | 317,401 | ..... | ..... | 317,401 | ..... |
| Ecuador | ..... | ..... | [4] 94,594 | ..... | 26,917 | 121,511 | ..... |
| Guiana: British | ..... | ..... | 3,846,701 | ..... | ..... | 3,846,701 | ..... |
| Paraguay | ..... | ..... | ..... | ..... | ..... | 4,835 | ..... |
| Peru | ..... | ..... | [3] 1,765,916 | ..... | ..... | 1,937,547 | ..... |
| Uruguay | ..... | ..... | [3] 2,680,597 | ..... | ..... | 2,939,438 | ..... |
| Venezuela | ..... | ..... | ..... | 8,879 | ..... | ..... | 8,879 |
| Total | 186,883 | 464,835 | 8,705,209 | 8,879 | 26,917 | 31,897,884 | 1,601,896 |

[1] From "Commercial Relations of the United States with Foreign Countries, Calendar Year, 1912," Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, 1914.
[2] Only United States reported. No figures for other countries.
[3] 1911.
[4] Rough and finished.

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TABLE IV.—*Import and export lumber trade of South America, 1912*—Continued.

EXPORTS.

| | Quebracho— | | Timber. | Wood and lumber. | Balsam copaiba. | Quillaya bark. | Balsam tolu. | Total. |
|---|---|---|---|---|---|---|---|---|
| | Extract. | Logs. | | | | | | |
| Argentina | 4,667,570 | 3,443,655 | | | | | | 8,111,225 |
| Chile | | | | | | [1] 9,287 | | 9,287 |
| Colombia | | | 68,572 | 15,289 | [1] 5,910 | | [1] 19,488 | 109,259 |
| Guiana: | | | | | | | | |
| British | | | 62,880 | | | | | 62,880 |
| Dutch | | | | [2] 9,839 | | | | 9,839 |
| Paraguay | | | 846,341 | | | | | 846,341 |
| Uruguay | [2] 22,747 | | | | | | | 22,747 |
| Venezuela | | | | 72,439 | 38,658 | | | 111,097 |
| Total | 4,690,317 | 3,443,655 | 977,743 | 97,567 | 44,568 | 9,287 | 19,488 | 9,282,625 |

[1] Exported to United States. No figures for other countries. [2] 1911.

From this very inadequate survey of the commercially valuable timber resources of South America, as we know them now, it may be seen that the real forest wealth of South America is not as great as one would naturally think from the vastness of the forest area, particularly if one bears in mind that the commercial forest does not occur in a solid body over the entire area and that a great deal of it has already been destroyed. Thus in Chile, according to Federico Albert,[1] inspector general of forests, hunting, and fisheries, the commercial forest area has now been reduced to 5,000,000 acres. Of the 89,000,000 acres classed as woodland 9,000,000 are pasture forest, 18,500,000 only firewood forest, 6,000,000 furnish only poles and stakes, leaving only about 5,000,000 acres of really commercial forest.

That the light, strong, and easily workable timber is the one that is most in demand even in South America is shown by the fact that in Argentine 80 per cent of the total annual consumption of lumber is imported from the United States, Canada, and Europe, and consists chiefly of pine and spruce, while the native hardwoods make up only about 10 per cent. The same is true of Uruguay. In Brazil, where the forest area of hardwoods is very large, 40 per cent of the total consumption is covered by importations of pine and spruce from the United States, Canada, and Europe, 30 per cent is supplied by the native pines, and the remaining 30 per cent is made up of native hardwoods. In Chile, the third in importance of the South American Republics, 55 per cent of the total wood consumption is covered by American and European importations and 45 per cent supplied by the native woods.

It is true that of the 47,000,000 board-feet of Parana pine which is cut annually in Brazil about 15,000,000 board-feet is exported, yet at the same time the United States, Canada, and Europe are sending to Brazil pine largely for similar uses in quantities averaging over four times this amount. An analysis of the export and import lumber trade of the whole of South America (see Table IV) shows a condition similar to that in Brazil. Thus, while the importations of lumber in 1912 amounted, exclusive of naval stores, to about $32,000,000, the exports of wood, exclusive of rubber, was a little over $9,000,000. Of this over half was quebracho extract logs. The amount of actual wood exports, therefore, was not more than $4,500,000, or about one-seventh as much as the wood imports. It is evident that at present the large forest

[1] Federico Albert: The Forests of Chile, Monthly Bull. of Agric. Intelligence and Plant Diseases, Vol. 5, 1914, pp. 1535–1541, Internatl. Inst. of Agric., Rome.

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area of South America does not even supply its home demand for soft, easily workable wood commonly used in general construction work. So much for the coniferous softwoods.

As far as hardwoods are concerned the present annual cut is almost sufficient to cover the home demand, consequently very little hardwood timber is imported into South America from the United States, Canada, or Europe. Judging from the figures available for Brazil, Uruguay, and Argentina the native hardwoods form only about 15 per cent of the total amount of wood used in South America—a rather insignificant amount.

At present the lumber industry of South America is still in a primitive condition. The inaccessibility of the forests, the absence of means of transportation, the lack of capital, and the sparseness of the population are undoubtedly responsible. The logging of tropical woods, even with improved methods, will always be a costly operation. Unless all of the mature trees in such a forest are marketable—a condition which can hardly be expected—the valuable species will always be found more or less scattered. To log them, therefore, will involve large expense of cutting roads to where the trees are felled. Furthermore, the tropical hardwoods are, as a rule, cumbersome to handle on account of weight. Not infrequently as many as 40 oxen are required for the transportation of one log. According to some estimates by large logging operators, it would cost $16.80 to haul 1,000 board-feet for a distance of 12½ miles. As is mostly the case in all new countries, the public-service transportation is expensive in Brazil. A railroad running through one of the most important forest sections charges about $15.90 per 1,000 feet, American log scale, for transporting logs a distance of 100 miles. Even in the Parana pine region, where the timber occurs in almost pure stands, one of the sawmills with a steam-power logging road and modern power skidding and logging machinery figures the cost of logs delivered on skids at the mill at $10.50 per 1,000 feet, not including stumpage.

The lumber industry is working under many difficulties and is confined to a few species. This explains largely such an apparently anomalous situation as that lumber from native woods is undersold in nearly every important market by high-grade imported lumber, in spite of the fact that the native forests are only from 100 to 300 miles from the points of consumption while the foreign lumber must be shipped from 4,000 to 5,000 miles and bears an import duty of 100 per cent ad valorem. These difficulties, however, are being gradually overcome. The lumbering of the Parana pine is already now on fairly solid basis and is making rapid progress. It is being developed largely by American lumbermen. At first, without fully understanding the properties of the Parana wood, they had trouble in handling it; but gradually, as men of more technical training become interested in its manufacture and the problems connected with its kiln drying are worked out in a practical way, an increasingly greater utilization of the timber is practically assured. Even now in some States it is the most formidable competitor of Scotch pine, American spruce, and white pine for box making. In southern Brazil it successfully replaces the American yellow pine for doors, flooring, blinds, and ceiling. There seems, therefore, to be very little doubt that in Parana pine South America has a softwood which can successfully take the place and therefore compete with the softwoods imported from the United States, Canada, and Europe, and that with the greater development of the native lumber industry the importation of the softwoods to South America will gradually decrease, and that eventually she will be able to supply her own demand for this kind of timber.

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The limited area, however, of these pine forests, together with the fact that South America is still a young country which will have to provide wood for a much larger population than she has now, makes it very doubtful that, even with the proper protection and management, she will ever become an exporter of softwoods to foreign markets. As regards hardwoods, however, South America, in spite of the difficulties of primitive methods in logging, is already capable of satisfying practically all of her needs, and is even exporting, in addition to extract and dyewood, some of the rarer woods. The vast hardwood forests of South America could undoubtedly be a source of large supplies of tropical hardwoods for interior finish for the world market, if it were not for the fact that the demand for heavy tropical woods will always be limited, and even the use of dyewoods is probably coming to an end shortly because of the progress made with chemical dyes. Furthermore, the weight of the tropical woods and the distance from markets will always be a serious obstacle in delivering such woods on a large scale at reasonable prices, especially at a time when wood is constantly coming more and more into competition with wood substitutes. Unless, therefore, the South American hardwoods are to be manufactured on the ground and exported as veneer or other partially manufactured product, or the cost of logging and transportation greatly reduced, they will hardly ever become a source of great export.

If our estimate of the timber resources of South America are anywhere correct, several conclusions suggest themselves.

First. In spite of apparently a vast forest area, the extent of commercially valuable timber is limited, and therefore it would be an obvious error to assume that the timber resources of South America are inexhaustible. The people of the United States have made a similar error in the past. Twenty years ago the white pine in Michigan was regarded as inexhaustible; to-day 6,000,000 acres, which 30 years ago carried the best white pine in the world, have been abandoned by their owners for taxes and lie almost wholly waste—a man-made desert, the combined result of a reckless use of the ax and a still more reckless disregard of fire. As it is, attention has already been repeatedly called to the danger of the extinction of the quebracho, since little or no check has been placed on the cutting of this wood. If the present cutting is permitted to continue, according to a very high Argentine authority, few existing quebracho trees will be left standing. There is constant outcry for the passing of immediate forestry laws, but as yet this very pressing matter has not obtained its share of consideration from Congress. Not only the quebracho but many other valuable species of trees with which the forests abound are in danger of extinction in the not very distant future as the result of inadequate forestry laws.

Second. The coniferous softwoods of South America will supply only the growing home population, and, therefore, their preservation becomes a matter of national importance, since, with the gradual exhaustion of the timber supply of the northern and temperate regions, the amount of softwood exported will gradually decrease and the price increase.

Third. South America has a vast amount of hardwoods, which is more than sufficient to supply her own needs for all time; but, as far as we know at present, it has comparatively few hardwoods beside Spanish cedar and several extract and dye woods, which may figure extensively in export trade. This vast hardwood forest is still unknown and furnishes a fertile field for exploration which may lead to the discovery of many species whose wood properties may change entirely the commercial aspect of the South American forests. The first task, therefore, of South American countries which are interested in the development of their forests is a thorough reconnaissance of their timber re-

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sources and a study of the technical properties of the different woods as a basis for an intelligent estimate of what those forests contain and what they have to offer to the lumber market of the world. If further study fails to discover any more valuable species than those already known it will still serve as a basis for a definite forest policy. It will indicate methods of logging and partial manufacture which may make possible a large export trade in these hardwoods. It may show the advisability of confining future management of those forests to the growth of only the most valuable species and the gradual elimination of the vast number of unutilizable trees or forest weeds. Such a policy, together with the rapid growth of the tropical trees, may tend to increase the commercial value of the forests. It may also dictate a definite land policy with regard to the clearing of certain kinds of forests for agricultural purposes and the advisability of retaining others for timber growth. Without such a reconnaissance and determination of the possible uses to which the tropical hardwoods are suited, a systematic and intelligent development of the timber resources can not be undertaken nor capital for their exploitation readily attracted. It is therefore in the interests of the countries whose economic progress depends on the development of their natural resources that such a reconnaissance should be undertaken and carried through as soon as possible.

## THE LESSON OF FORESTRY IN THE PHILIPPINE ISLANDS.

By MAJ. GEORGE P. AHERN,

*Former Director of the Bureau of Forestry, Philippine Islands.*

The members of this congress, I hope, will pardon my liberty for presenting to them a subject apparently so far removed from the territorial limits of either North or South America; but my reason for accepting the invitation to take part in the proceedings of this congress was that the lessons learned in forest development in the Philippines are of live interest to tropical America. There is, between the two regions, a close similarity of forest, climatic, and economic conditions.

We found in the Philippine Islands, in 1900, vast stretches of unmapped and sparsely inhabited forests, which contained a large number of unknown and nonmerchantable tree species. The country was blessed with a fine tropical climate very favorable to plant growth, fertile soil, and vast areas of virgin and second-growth forests. No effort had been employed to make any real use of these great areas. Communities living in sight of virgin forests imported lumber from abroad. Near such forests were people living in houses of thatch and bamboo. The main reason for this nondevelopment was the great lack of transportation. Far from making any commercial use of the forests of these regions, the principal industry of the inhabitants seemed to be forest destruction by a system of shifting agriculture described later.

### AREA—CLIMATE.

The general situation and the climatic conditions of the Philippines, I have said, are similar to those of tropical America. The Philippine Islands, with an area of more than 115,000 square miles, lie entirely within the Tropics. The topography is mountainous, the highest peaks approximating 10,000 feet above sea level and many more than 8,000 feet. The mountains are volcanic in

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origin, some of them being still active. The coastal and river plains vary in width, in a few instances running up to 30 or 40 miles, but as a rule they attain but a few miles. This archipelago is one of the most fertile undeveloped regions in the Orient. The soil is largely volcanic in origin. The rainfall varies from 40 to 160 inches.

### POPULATION.

The population of the Islands, chiefly Malay in origin, comprises 7,000,000 Christians and 1,000,000 non-Christians, the latter including 30,000 Negritos, an inferior black race. The Filipino, who owes much to the civilizing influence of three centuries of Spanish rule, is, unlike all other orientals, Christian and self-governing.

### FORESTRY DURING THE SPANISH RÉGIME.

It was not until 1863 that the first effort was made to establish a forestry bureau in the Philippines. There had been some beginnings of a forest service in Spain. A glance at the history of the Spanish forest service carries a lesson to all of us. The earliest known forest legislation in Spain, enacted in 1351, imposed heavy fines on forest trespassers. From this time on we note that, periodically, spasmodic and unsuccessful efforts were made to stop forest devastation; but it was not until 1833 that the first step in the right direction was made—viz, the organization of a forest service. This service, however, was not sustained as it should have been, owing to political interference. In 1840 several young Spaniards were sent to a forest school in Germany. Upon their return to Spain a new interest was awakened, and, as a result of their efforts, a forest school was established in 1846. In 1853 a forest department was organized, but again it was crippled by numerous political appointments. During the five centuries following the first forest legislation, regulations, fines, etc., all went for nothing. The fatal lack was an organized personnel supported by public sentiment. Forest devastation went on unchecked until the young men trained in the country developed a public sentiment in favor of conservation of forest resources, and then came the first signs of substantial progress. The same story is repeated in the history of every country with a forest service, and will be repeated in countries at present without an effective forest service.

*Forestry in the Philippine Islands.*—The first Spanish foresters were sent to the Philippines in 1863. The service grew until it numbered more than 120 officers of all grades. All of the higher positions were filled by Spaniards, who retained their grades at home while serving abroad. During the 35 years of forest service the work accomplished consisted of fair botanical collections, some land classification, maps of a few forests, and a system of forest administration, which enabled the inhabitants to use the forests in a small way under a license system. Forest officers gathered but little information concerning their extent and value. Nevertheless it is to the credit of Spain that this beginning of a forest service was made in the Philippines.

It was in April, 1900, that I was directed by the military governor of the Philippines to take charge of the office known in Spanish times as the "Inspeccion de montes," or bureau of forestry. The records were gathered and a few of the former employees of the lower grades presented themselves and were taken into the service.

The islands at that time were in the midst of a wide-spread insurrection. The forests were the refuge of the disaffected, and not very desirable or safe for the peaceful work of a forest officer. In the face of great difficulties, even

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dangers, a number of field parties, even during the first two years, accomplished much in the way of reconnoissance. Large botanical collections were made, including wood specimens; valuation surveys were run; topographic and other data were collected. It was then that the difficulties to be surmounted in forming a forest policy were realized: a forest flora of several thousand tree species, the great majority of which were unknown; our meager knowledge of Philippine forest botany; and no herbarium, or suitable library, at hand for reference. As soon as the bureau secured the services of a botanist (in 1902, to be exact) he was sent with the botanical collections to Buitenzorg, Java, to study the collections and to observe the methods in vogue at that famous botanical institution. Many profitable lessons were learned at this time; the Dutch authorities were generous in the matter of exchanges and started us on the right path; arrangements were made for exchange with other tropical gardens; and within a few years the Philippine herbarium had grown to large size, boasting some 150,000 sheets, including more than 2,500 tree species. Each forest station in the Islands now has the nucleus of a working herbarium.

One of the first discoveries brought out by field work and botanical investigation was that 75 per cent of the standing timber was composed of trees of one family—viz, *Dipterocarpaceae*, comprising some 23 species. The question at once arose, Was such a forest worth developing? Could this timber be made merchantable? At the outset we were informed that valuable timber was scarce, the trees much scattered, and that logging railroads and other modern equipment were not feasible. Up to that time the lumbermen with very primitive equipment were taking from the forest a few valuable trees and averaging less than 1,000 board feet per acre. Only the medium and pole sized trees of valuable species were taken. From such methods the forest had suffered but little, but, on the other hand, its possibilities were totally unrealized.

It was soon ascertained that the forests contained a wealth of from 10,000 to more than 40,000 board-feet per acre of trees of this *Dipterocarp* family. A vigorous campaign was then started to bring the valuable qualities of these woods to the knowledge of the market. The bureau opened up a workshop and timber-testing laboratory with a number of cabinetmakers and carpenters, a competent superintendent for each department, and a full set of the best equipment. An elaborate series of timber tests was inaugurated following the methods adopted by the United States Forest Service. This was done to afford a basis of comparison with woods familiar to contractors and engineers. Durability tests were also begun along various lines. Show rooms were fitted up with finished and unfinished wood and other forest specimens arranged with full labels, so as to make them attractive in the local market. Within a few years these hitherto abundant and unmarketable woods were finding favor in an ever-widening market.

With the transfer, at my suggestion, in 1905, of all revenue collecting to the bureau of internal revenue, came our opportunity for much needed investigative field work; and this in spite of some reduction in funds and clerical force. The first step was to make tentative working plans of a few attractive forest tracts and then locate on them modern lumbering and logging enterprises. This was accomplished and then the field force was assigned to making a rapid reconnoissance and forest map of a large part of the Islands. This required the work of a number of parties for the better part of two years. After that the field force kept three or four preliminary working plans ready for prospective investors.

The manner of granting concessions to companies is as follows: Exclusive licenses or concessions, as they are called, are generally in the form of a 20-

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year exclusive license to cut and extract timber and other forest products from a specified tract. The land is in no way affected by such a license, merely the timber and minor forest products being included. Homestead and free-use privileges are allowed in such tracts. In fact, the rights of the people of the vicinity are carefully safeguarded in the contract, even to the maximum charge which may be imposed by the company on lumber desired for local needs. When a lumberman is seriously considering an investment in the Philippines, he himself or an experienced representative states to the director of forestry, approximately, the extent of the investment he contemplates. He is then given information about several tracts which promise to answer his needs, and arrangements can be made for an experienced forester to accompany him over the tracts in question so that he may judge of conditions for himself. All maps, estimates, and other detailed information which may have been collected on the tracts, will, of course, be placed at his disposal. He can count upon the heartiest governmental cooperation and assistance in making his enterprise a success. If the lumberman decides to apply for a concession he makes a formal application in writing to the director of forestry for an exclusive 20-year privilege for the tract selected. His application is then forwarded to the Secretary of the Interior for the latter's approval. If approved, formal bids to secure the desired privilege are requested through the public press.

Usually four months intervene between the appearance of the first advertisement and the opening of the bids, in order to give interested parties ample time to correspond with their principals in Europe or America. The advertisement also enumerates certain minimum requirements which principally specify the minimum amount of capital which must be invested within a certain given time, the minimum cut during the several succeeding years, together with certain requirements regarding logging and milling equipment. The license is ordinarily granted to the bidder who gives the best assurances of developing the tract most thoroughly and promptly. The right of rejecting all bids is expressly reserved. In fixing an annual production there is taken into consideration, as far as possible, the amount of overmature timber in the stand and the amount of annual increment, with the object of rendering the investment a permanent one instead of merely permitting the operator to strip and abandon the area he holds. In preparing regulations under which the operator is required to work, first, care is given to the future condition of the area in order that the permanent forest land, after logging, may be potentially as valuable, and no consideration of immediate profit is allowed to interfere. It is to permit such permanent use of the land that concessions are granted over very large areas, often consisting of more than 100 square miles. No payment is required for this privilege, but usually a bond of $5,000 is demanded as a guaranty that the terms of the contract will be followed. Payment of forest charges is required within 30 days after manifesting the products collected.

Concessions to large companies are preferable. The actual supervision of the operations of approximately 6,000 licensees and a large number of free users, taxes to the utmost the small field force of a little more than 100 forest officers. In 1913 eight holders of timber concessions took out one-third the total output of timber; the remaining two-thirds was taken out by 1,209 timber licensees. The supervision of the work of large companies is comparatively simple and requires the services of but few forest officers, and the results are more satisfactory, as far as cooperation with bureau requirements is concerned.

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Timber concessions are held not only by American companies, but also by British, Chinese, German, and others. These companies, with connections in various parts of the world, facilitate the widening of our markets for forest products far more than if all concessions were granted only to Americans.

Such is, in brief, the evolution of our Philippine forest industry since 1900. Let us take a look at the timber which this system protects, fosters, and introduces to the commercial world.

### THE FORESTS OF THE PHILIPPINES.

The forests of the Philippines, without doubt, extended at one time from the coasts to the mountain tops; but man and other destructive agencies have destroyed much of the forest cover. On the islands where there is a large population to the square mile there is but little or no forest. Virgin forests are found far removed from large settlements.

The following table gives the estimated area of the different classes of vegetation:

| | Area (square miles). | Percentage. |
|---|---|---|
| Improved lands | 12,000 | 10 |
| Grasslands | 48,000 | 40 |
| Second-growth forests | 20,000 | 16⅔ |
| Virgin forests | 40,000 | 33⅓ |

*Improved lands.*—Under improved lands are included urban areas and agricultural lands. During the most prosperous of Spanish times in the islands the area of improved land approximated that given in the table. But during the last insurrection, and for a few years subsequent thereto, it fell to less than half of that indicated. During the past few years this area has increased to about that given in the table.

*Grass lands.*—The grass lands, known as Cogonales, are covered principally with two species of wild grass—one called *Cogon, Imperator exaltata,* the other *Talihib, Saecharum spontaneum.* If these grasses are kept down for a couple of years a finer grass follows, which serves as a good forage for live stock. The forest area is perceptibly reduced and the acreage of grass land increased by the native evil known as the Caingin. This greatest forest evil in the Tropics is due to the methods of nomadic or shifting agriculturists, who enter a small patch of forest, two to three acres, fell the trees at the beginning of the dry season, and at its close fire the felled material.

*Second-growth forests.*—It is the shifting agriculturist, or Cainginero, who is usually responsible for the type of forest known as the second-growth forest. On Caingins, where fires do not occur for a few years, the young-tree growth often conquers the grass and weeds and takes possession of the ground. Some of these fast-growing and light-loving species occur in pure stands, and are used locally for fencing, firewood, and occasionally for house building. Under this partial shade other less light-loving species take hold and in time may supplant the original species. If fires are kept out of such tracts an opportunity is thus given for the development and growth of a forest approaching in character the so-called virgin forest.

*Virgin forests.*—The virgin forests, which cover two-thirds of the forest area, form a source from which a large part of the lumber supplies are produced. They include the protective forests of the high mountain region.

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*Private woodlands.*—Less than 1 per cent of the forests are held under private title. The forest law provides that titles to all private woodlands must be registered in the bureau of forestry. Up to date practically all such lands have been registered. The entire forest area, comprising the virgin forest and the second-gowth forest, is equal to the combined areas of the New England States.

The total forest area, including both virgin forest and second-growth, may be divided according to the trees produced into the following types, which are given with a very rough estimate of the area occupied and of the volume:

| Forest types. | Area occupied. | Volume of standing timber. | |
|---|---|---|---|
| | | Board-feet per acre. | Million board-feet. |
| | *Sq. miles.* | | |
| Dipterocarp | 30,000 | 10,000 | 192,000 |
| Molave | 4,000 | 3,000 | 7,680 |
| Pine | 2,000 | 2,000 | 2,500 |
| Mangrove | 800 | ..... | ..... |
| Beach | ..... | ..... | ..... |
| Mossy | 3,200 | (1) | ..... |
| Total | ..... | ..... | 203,204 |

[1] Purely protective.

The principal tree family of the Philippines is that of the Dipterocarpaceæ. Upward of 28 species of this family constitute the bulk of the merchantable timber of the islands. Fully 75 per cent of the timber of the islands belong to this family, the trees of which, covering 30,000 square miles of the virgin forest area, are found on all types of topography from the coast line up to 800 meters altitude. The trees of this family are all large trees, reaching heights of 40 to 50 meters, with diameters of 100 to 150 centimeters or more, and with straight, regular boles.

Next to the Dipterocarp, the most frequent forest type in the islands is the Molave, named from the tree *Molave, Vitex parviflora*, found throughout this type. Its wood is deemed by the natives the most valuable in the islands, owing to its strength and durability. It is in great demand by contractors and engineers and quite often by cabinetmakers, as it takes a fine finish and makes a handsome appearance. Its greatest quality is its durability. The tree is found in the coastal plains and river valleys and on low-lying islands over a limestone formation. The forests are open and of light stand, averaging less than 4,000 board-feet per acre.

Other types are the mangrove, which as a source of wealth is not yet fully appreciated; the beach type, depleted from its nearness to the settlements; the pine type; and the mossy type of the high, wind-swept regions.

### ORGANIZATION AND WORK OF BUREAU.

A brief résumé of the system for organizing and administering the forest organization work in the Philippines may not be out of place. Section 2 of the forest act (1148) reads as follows:

SECTION 2. The public forests and forest reserves of the Philippine Islands shall be held and administered for the protection of the public interests, the

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utility and safety of the forests, and the perpetuation thereof in productive condition by wise use, and it is the purpose of this act to provide for the same.

Also act No. 1189, section 130, reads in part as follows:

The demarcation, protection, management, reproduction, occupancy, and use of all public forests and forest reserves shall be in accordance with the provision of the forest act and of all laws and regulations now in force or which may hereafter be enacted or prescribed. The Chief of the Bureau of Forestry shall, under the authority of the Secretary of the Interior, prescribe all necessary regulations governing the use of all public forests and forest reserves and shall be charged through his subordinates with the enforcement of the laws and regulations regarding the demarcation, protection, management, and reproduction of all public forests and forest reserves and of their use or occupancy by any person, firm, association, or corporation; and all forestry inspectors, rangers, and other officials of the Bureau of Forestry shall in addition be charged with the classification and appraisal of all forest products cut, gathered, or removed from the public forest and forest reserves and shall cooperate with the internal-revenue officials in securing the full payment of the internal-revenue taxes imposed on such products and with the enforcement of the provisions of this article.

The performance of the duty here charged necessitates five lines of work, viz: (1) Administration, (2) research, (3) protection, (4) reproduction, (5) propaganda.

The forests are administered under a system of licenses granted by and under authority of the director of the forestry. By this system approved licensees are given the privilege of cutting specified amounts of timber and other forest products from specified areas for a specified length of time. All cutting and collecting is required to be performed under scientific forest management, the silvicultural methods in each case being adapted to the particular species and condition of the locality. To facilitate the work the islands are divided into 11 forest districts, which are subdivided into 36 stations. The officers at each station have charge of all forest matters within their jurisdiction. They familiarize themselves with the operations of all licensees, collect data, topographical, botanical, etc., within their territory, so that they may become thoroughly acquainted with the forest resources and possibilities of the area under their control. At the same time, the forest officers carry on a vigorous propaganda among the people, assist the public schools in caring for their tree nurseries, cooperate with other Government officials in protecting the forest from fire, trespass, and other dangers. Their most important work is to arouse a public sentiment in favor of forest conservation, for without that all other work would be of no avail. The bureau must also safeguard all public lands, under law, from alienation to agricultural purposes when fit only for forest uses. Hence it sees to the examination of all parcels of public land applied for as homesteads, for lease, or for purchase, with resulting certificate as to their agricultural or forest value. The congressional act of July, 1902 (Public, No. 235), reads in part as follows:

SECTION 18. * * * No timber lands forming part of the public domain shall be sold, leased, or entered until the Government of said islands, upon the certification of the Forestry Bureau that said lands are more valuable for agricultural than for forest uses, shall declare such lands so certified to be agricultural in character.

Thus, before any public land can be alienated an examination must be made by forest officers and certification made by the Bureau of Forestry.

All research work in the bureau is looked after by the Division of Investigation, and consists of carrying on intensive studies—(*a*) as to the silvicultural systems of forest management adapted to the various conditions in the Philip-

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pine Islands with the object of raising the standard of forest administration; (*b*) as to the physical and other characteristics of the various kinds of timber and other forest products, to assist in their ready identification, and to extend the field of their usefulness, thus opening up new avenues of trade and revenue.

The protective branch of the work requires that, in conformity with sections 23 and 25 of the forest act (No. 1148), it be part of the duties of all members of the bureau to prevent violations of the forest law and regulations and to assist in the prosecution of all offenders. The principal violations consist in the making of illegal caingins and the gathering of forest products without authority.

Reforestation is employed, so far as the funds permit, for bringing again into productive condition all waste areas, deforested in the past, and also for the substitution of valuable species for inferior growth existing at present. To facilitate this work, investigation at the forest school nurseries over a period of years with several hundred tree species, developed the fact that several valuable trees grew rapidly in the nursery and plantations under adverse conditions. The woods of these trees are not only in demand, but the forms are such as to make them desirable for roadside and other planting. Supplies of these tree seeds are distributed to the nurseries connected with public school gardens, to all persons interested in tree planting, and for arbor day use. Within a few years a stock of these trees will be found in every Province, thus providing centers of future seed distribution.

Finally, the Forest Service conducts an active and energetic propaganda. To encourage the more extensive use of the public forests, the bureau collects and compiles information concerning the commercial advantages they offer, makes forest maps, and estimates of tracts suitable for large logging operations, showing the location, amount, and qualities of the commercial timber and minor forest products, together with the estimates of the cost of the logging operations proposed. These results are given the widest possible circulation by means of reports, bulletins, newspaper and magazine articles, and correspondence in quarters where they will be most effective in promoting trade in Philippine products. In addition a commercial forest museum is maintained in Manila.

### EDUCATIONAL WORK.

The educational work of the bureau is restricted to giving to selected Filipinos an elementary course in forestry so as to fit them to carry on the various lines of work with which the bureau is charged. Since the spring of 1910 all educational work has been centered at the forest school, college of agriculture, University of the Philippines, located at Los Banos, Laguna. This is also the site of the Maquiling forest reserve and also the headquarters of the Division of Investigation. This concentration enabled its members, who are charged with the research work of the bureau, jointly to carry on silvicultural studies in the forest reserve and to give technical instruction to the students in the school. The school course covers a period of two years and includes studies of large logging operations. The Government provides 20 scholarships per year, the students being selected from among the most suitable high school graduates.

This 15 years history of forestry in the Philippines has developed a self-supporting organization with a personnel of 200, an exhaustive acquaintance with the forest resources, and a practical policy of conservation and utilization. There is, I think, a lesson here for tropical America, with her similar conditions of situation, climate, and forest conditions. The forests of tropical America are vast; they are not being utilized to the best advantage, and the



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Government derives but little revenue from them. The markets of the world will need the forest products from tropical America more and more each year, and this new source of supply will in time prove much more prolific than is now credited. Moreover, forestry proves an entering wedge for other forms of progress. Let us glance for a moment at the marvelous developments in other directions which crowd rapidly upon the opening of a large lumbering operation. Acres of ground are cleared for a mill site. A large modern mill, surrounded by a mass of buildings, sheds, railroads, docks, etc., springs up like magic; shopkeepers, artisans, truck gardeners, etc., soon follow. All available agricultural land immediately tributary to the site is promptly seized and small farms of rice, corn, sweet potatoes, and sugar begin to change the landscape. The large quantities of supplies, the streams of labor to replace gaps caused by employees leaving the company to take up land or other work in the vicinity, necessitates the regular run of the company's steamers from the nearest seaport. Every effort is made by the company to assist the young community in securing its supplies and marketing its products. But before long other lines of transportation appear, and the young community outgrows its dependence on the big plant that brought it into being. Such rapid and extensive development has occurred in several forested regions in the Philippines.

Judging from the experience of other countries now wisely and profitably controlling their forest resources, what are the prospects for forest conservation in tropical America? Many men of the countries to the south of us have shown marked ability in science; they have mastered many of the problems of government; much progress has been made in various departments of agriculture; much botanical work of a high order has been accomplished; their universities are well equipped, but forestry training and the study of their forest flora have been neglected; comparatively few of the forest products have been exploited; but little is known of the great variety of tree species and other forest products now going to waste in tropical America; and, when the world's markets are ready for them, how can these vast areas of forest wealth be utilized to the best interest of the countries concerned? As one who undertook to solve just such a problem in the Philippines 15 years ago, and who did so without expense to the Government—in fact, from the very first year turned in a substantial surplus over all expenses—I venture to suggest the following program of action: Arrange for a number of the many young men who are studying science abroad to take courses in forestry after securing their degrees in science. Meantime, while waiting for the first students to complete their forestry work, secure tropical experts from abroad, aided by local botanical collectors, for field reconnoissance. Let the field parties include in their work forest maps and large log collections representing the dominant tree species of each region. If these logs are collected under rules similar to those laid down by the United States Forest Service, they should be sent to a timber-testing laboratory and to the large centers where wood is manufactured for furniture, veneer, and interior finish for examination and exhibition. Desirable qualities of these woods will then be brought to the attention of wood users. Field investigation will show the approximate stand of such trees to the acre and will furnish the Government with data sufficient to make forest concessions attractive to investors. Timber concessions should be granted for periods of from 10 to 20 years; stumpage charges should be comparatively low and restrictions carefully formulated, so that both the Government's and the investors' interests will be safeguarded.

As soon as practicable after the forest students return to their different countries they should, first, acquaint themselves with forest conditions; then they

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should be given places as instructors in forestry in their universities. A propaganda in favor of conservation will follow. After this the work will go on without further difficulty. Up to the present lumber capitalists have been timid about investing in tropical forests, owing partly to dread of certain diseases believed to be ever present in the jungle. Now that medical science has conquered the jungle and the swamp, this fear of the capitalist will no longer deter him, and especially since the forest tracts of the Temperate Zones will soon be taken up and new fields for investment must be sought. The time is ripe. Tropical America will do well to study its forest resources and prepare to develop them by wise use.

TABLE No. 1.—*Statement of applications for homestead purchase and lease of public lands certified to Bureau of Lands as more valuable for agriculture than for forest purposes.*

| | 1905–1913 | | | 1914 | | |
|---|---|---|---|---|---|---|
| | Agriculture. | Forest.[1] | Total. | Agriculture. | Forest.[1] | Total. |
| Homesteads | 19,715 | 2,299 | 22,014 | 4,812 | 685 | 5,497 |
| Sale application | 765 | 106 | 871 | 279 | 36 | 315 |
| Lease | 350 | 9 | 359 | 77 | 1 | 78 |
| | | | 23,244 | | | 5,890 |

Total applications pending inspection Dec. 31, 1914, 2,961.
[1] The column "Forest" indicates the number of applications for public lands certified as more valuable for forest purposes and not alienable.

TABLE No. 2.—*Revenues derived from sale of forest products and expenses of the Bureau of Forestry since its organization, Apr. 14, 1900.*

| | Revenue. | Expenses. | Percentage. | Surplus. |
|---|---|---|---|---|
| 1914 | $221,330 | $128,495 | 58 | ..... |
| 1900–1914 | 2,438,945 | 1,292,537 | 59.6 | $1,146,408 |

LICENSES IN FORCE, 1914 (JAN. 1–DEC. 31).

| | Number of licenses. | Total. |
|---|---|---|
| Forest products: | | |
| Timber, commercial | 1,483 | |
| Timber, gratuitous | 2,413 | |
| | | 3,896 |
| Minor products: | | |
| Firewood | 692 | |
| Charcoal | 53 | |
| Dyewood | 8 | |
| Tan bark and dye bark | 148 | |
| Wood oils | 26 | |
| Resins | 161 | |
| Gutta-percha | 46 | |
| Rattans | 856 | |
| Others | 11 | |
| | | 2,001 |
| | | 5,897 |

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TABLE No. 8.—*Report of the utilization of forest products from public forests of the Philippine Islands during the fiscal year Jan. 1–Dec. 31, 1914.*

| | Cubic meters. | Kilos. | Liters. |
|---|---|---|---|
| Forest products: | | | |
| Timber | 294,688 | ..... | ..... |
| Firewood | 193,859 | ..... | ..... |
| Charcoal | 2,682 | ..... | ..... |
| Dyewood | ..... | 493,568 | ..... |
| Tan bark | ..... | 2,793,295 | ..... |
| Dye bark | ..... | 58,714 | ..... |
| Gum mastic | ..... | 1,199,404 | ..... |
| Pitch | ..... | 50,576 | ..... |
| Gutta-percha | ..... | 76,952 | ..... |
| Rattan (split) | ..... | 3,316,925 | ..... |
| Rattan (unsplit) | 10,415,000 | ..... | ..... |
| Rattan dilliman (for fish traps) | ..... | 114,053 | ..... |
| Stone | ..... | 127,175 | ..... |
| Beeswax | ..... | 297 | ..... |
| Gogo (soap fiber) | ..... | 13,956 | ..... |
| Wood oils | ..... | ..... | 117,561 |

Appropriation, year 1914, $131,692.25; revenue, $221,330.30; expenditures, $128,495.16; surplus, $92,835.15.

## Adjournment.

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## GENERAL SESSION OF SECTION III.[1]

RALEIGH HOTEL,
*Monday afternoon, January 3, 1916.*

Chairman, GEORGE M. ROMMEL.

The session was called to order at 2.30 o'clock by the chairman.

Papers presented:

Plant introduction opportunities open to all the Americas, by David Fairchild.

How an animal grows, by H. J. Waters.

Securing settlers for private irrigation projects, by H. G. Shedd.

### PLANT INTRODUCTION OPPORTUNITIES OPEN TO ALL THE AMERICAS.

By DAVID FAIRCHILD,

*Agricultural Explorer in Charge, Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry, United States Department of Agriculture.*

There have never been questions of such world importance as those which are filling our minds to-day, and it is no wonder that civilized man is turning with outstretched hands to the men of science who have solved so many questions and helped him in so many ways. Mysticism and superstition no longer satisfy him and the only hope which remains is that the scientific methods of research will be able to reveal the path which the human organism is destined to travel from now on, in its development on this planet. For this reason this congress, which is for the purpose of creating and promoting cordiality and cooperation among the scientific men of all the Americas, is of very great importance. Each new invention in transportation increases enormously the possibilities for human beings all over the world to know one another, and any theory which fails to recognize this inevitable spread and territorial intermingling of the races of mankind will be swept into oblivion.

It is with this conviction and in the spirit of complete racial sympathy that I wish to emphasize an avenue of friendly exchange of courtesy between the nations of the Western Hemisphere, which has received too little attention hitherto. I refer to the exchange between one country and another of the plants on which we live.

The plants which grow in our fields and forests are peculiarly our own—a part of our national life—and yet I doubt if any nation has ever received the thanks of another for the gift of a valuable plant. Has the civilized world ever recognized its debt to Peru for the potato—that wonderful tuber which

[1] There was no stenographic report of this session.



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has become the main staple food upon which its populace has lived for centuries? The tomato, too, comes from that same country and is so widely grown and eaten that its origin has been generally forgotten. Corn, one of the greatest producers of pork and beef and therefore of human beings, is almost certainly the gift to the world of Central America. The sweet potato, the peanut, the Lima bean, all came to us from the west coast of the great South American Continent.

There are a few things, such as tea, the history of which people remember and for which they are thankful to the countries which gave them, but how rarely when eating a pineapple or a navel seedless orange is one grateful to Brazil for having scattered these two most delicious fruits through the subtropics, and how very few are the people who think of the West Indies as the land which furnished to the world the finest variety of that vegetable fiber from which more fabrics are made than from all other materials put together—the cotton fiber.

These and very many more plant gifts South and Central America have given to the world, and all without any official recognition or thanks. What I wish to urge in this short address is that the importance of these great gifts be realized and that this be impressed upon the people of all the Americas—the fact that the interchange of these important plants should be made occasions of international courtesy and their distribution should be utilized to emphasize the friendly feeling which exists between those from whose homeland the plants come, and those who grow them for the first time in some distant country.

To sit and look out of my study window through the branches of a Japanese flowering cherry tree gives me a kindly feeling toward the people of Japan, who are so fond of these blossoms that when the trees bloom their congress adjourns to see them.

To walk through a field of mandioca, or eat the crisp white cakes made from its root, gives one a new interest in South America. To pick the green fruits of the avocado from a tree on your own place and find out that there are many South Americans who feel that no meal is complete without it ("Sin aguacate no puede comer"), makes you want to visit the land from which it came. Our Governments should recognize in this interchange of plants great agencies of peace. It is too important a matter to be left to chance that one country may give to another a new food plant which will be grown over thousands of square miles of its agricultural lands and furnish food to millions of its citizens. Governments should recognize this altruistic opportunity. The giving of a new plant does not rob the giver either, but enriches instead the neighbor and makes him a better purchaser. Should not all Governments therefore organize agencies to promote this exchange?

In order to bring this subject before you in a practical way I would like to show you how the plant introduction program has thus far been carried out in the United States and some of the machinery which has been developed for the purpose of doing this work, and to point out a few of the many plant introduction opportunities which are still open to all of the Americas.

Without a system of some sort, plant introduction by the Government is likely to be a wasteful affair. The needless repetition of the same experiment and the danger of introducing either insect or fungus pests has led to the adoption of a regular system of bookkeeping and card catalogue indexing, by means of which it is possible to trace most of these introduced plants even years after they have been brought in, and to find out where they are and how they are growing.

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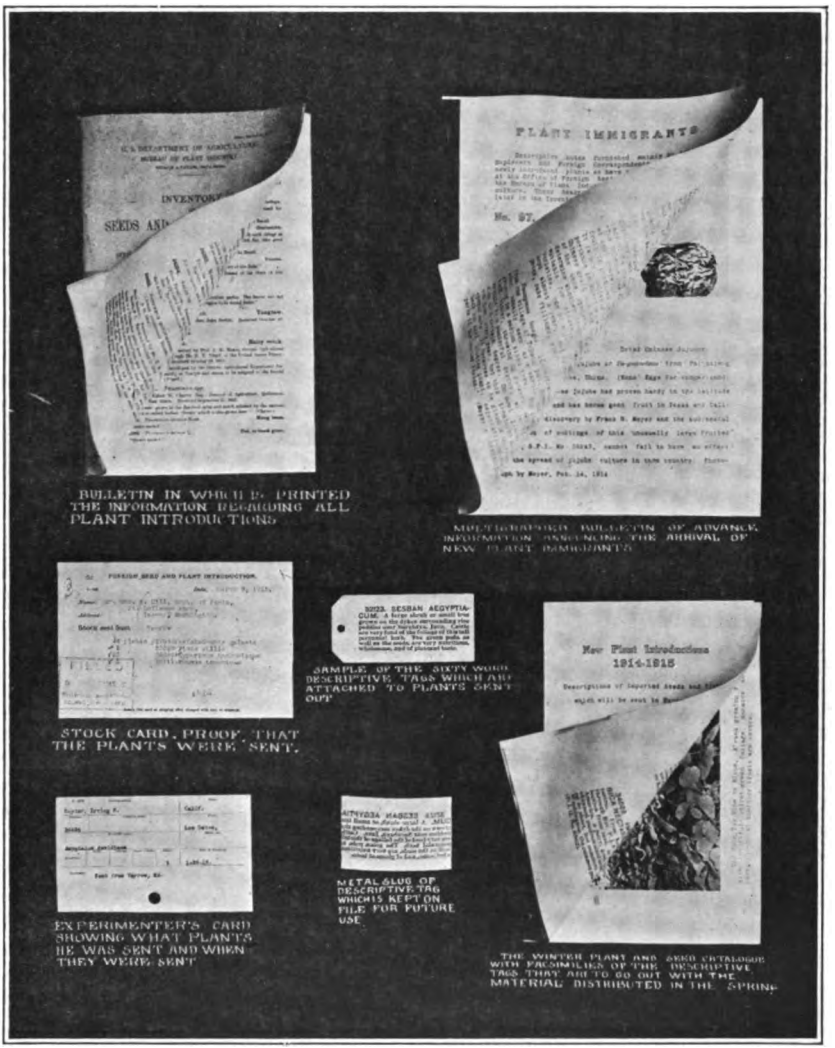
BULLETIN IN WHICH IS PRINTED THE INFORMATION REGARDING ALL PLANT INTRODUCTIONS
MULTIGRAPHED BULLETIN OF ADVANCE INFORMATION ANNOUNCING THE ARRIVAL OF NEW PLANT IMMIGRANTS
STOCK CARD, PROOF THAT THE PLANTS WERE SENT.
SAMPLE OF THE SIXTY WORD DESCRIPTIVE TAGS WHICH ARE ATTACHED TO PLANTS SENT OUT
EXPERIMENTER'S CARD SHOWING WHAT PLANTS HE WAS SENT AND WHEN THEY WERE SENT
METAL SLUG OF DESCRIPTIVE TAG WHICH IS KEPT ON FILE FOR FUTURE USE
THE WINTER PLANT AND SEED CATALOGUE WITH FACSIMILES OF THE DESCRIPTIVE TAGS THAT ARE TO GO OUT WITH THE MATERIAL DISTRIBUTED IN THE SPRING

The work of bringing new plants into a country and disseminating them among the people requires a regular system which will record each step of the operation. The machinery used in this American office is shown above. The Inventory (upper left) contains published descriptions of every plant brought in, arranged chronologically; it appears quarterly. The Plant Immigrants (upper right) appears monthly, is illustrated, and gives accounts of the behavior of plants already introduced and explorers' notes. The New Plant Introductions (lower right) is a catalogue issued each winter, listing the plants which are available for experimenters. The stock card and experimenter's card (lower and center left) record to whom the plants were sent and when. The sixty-word field label (center) is attached to every shipment of plants sent out, and the metal slug from which the tags are made is kept on file.

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If for any reason whatever it should be desirable to annihilate some newly introduced plant, this system will facilitate immensely the work of extermination.

It is now recognized that plants require the same careful treatment with regard to their diseases that human beings do, for certain of these diseases are quite as infectious and as fatal to plants in large plantations as cholera and smallpox are to man in congested cities. For this reason the United States Government has prohibited the bringing in of new plants from out of the way regions except by special Federal permit or through the Government Office of Plant Introduction, and a system of inspection and quarantine has been worked out so that every new plant coming in is examined by every known method to detect the presence of diseases. To facilitate this careful microscopic examination of all material, and give any necessary hospital treatment to diseased or suspectedly infected plants, a special quarantine-inspection house and plant-detention greenhouse has been built, the first of its kind in the world so far as I am aware. This house contains an inspecting room that is insect proof, with cement floor and walls. There are operating tables which can be disinfected with corrosive sublimate, ice chests in which plant material can be stored at a constant temperature which will keep it alive, a fumigating cylinder in which plants can be put and fumigated with hydrocyanic acid gas, and an incinerator in which all diseased material is burned to ashes.

Connected with this inspection room is a series of small greenhouse compartments made insect tight with fine mesh copper screens, each independent of the other, like wards in a hospital. Into these all suspected plants are put and forced into growth (incubated) to determine whether the diseases which they were suspected of having are of a parasitic and dangerous nature.

After passing through this quarantine house the plants are either declared free to be sent out to experimenters scattered over the country, or are sent to special gardens or other greenhouses which are periodically inspected by the various officers of the Federal Horticultural Board.

It is believed that this equipment safeguards the country from the introduction of any dangerous insect or fungous pest through the Government agency, and will insure the introduction of a new crop rid of the diseases to which it is heir in its native country. This is what might be called the negative side of plant introduction work. On the positive side this governmental organization must be prepared to meet all the reasonable demands of the plant growers of the country for new plants, and be able to supply the growers promptly with a small amount of any desirable new variety from abroad.

With such an organization a very large amount of introduction work can be done; hundreds of thousands of new plants can be distributed to experimenters annually. Since the United States Department of Agriculture organized its Office of Foreign Seed and Plant Introduction in 1898, over 41,000 plant introductions have been made. Some of these are to-day making ten times more wealth every year for the farmers of the United States than the Government has expended upon all the introduction work since it started. The durum wheat alone, one of Russia's gifts, is worth now to us over $30,000,000 a year. A hundred years ago mission padres came from the west coast of South America bringing the alfalfa plant with them into our great western country, and to-day our railway trains travel for hours through vast fields of this great food-producing plant. Peru has recently sent us a new variety better than the old one for our southwestern irrigated areas.

Egypt has given us her long-staple cotton, and profitable fields of it are being cultivated in our southwestern country. We have also from Africa the

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kaffirs, milos, and feterita sorghums, those drought-resistant grain crops which grow where corn fails.

Japan has sent us short-kerneled, early-maturing rices, which have borne large crops of grain in regions of America unsuited to the growth of the sorts which we already had. She has sent us her most popular fruit tree, the Japanese persimmon, and also the Satsuma orange, and her beautiful flowering cherry trees in all their varieties of loveliness. She has given us the soy and adzuki beans, great soil improvers and oil-producing crops for our southern fields. She is now sending us many of her wonderful bamboos.

From China come many fine, hardy plants; a dry land wild peach, for example, to be used as a stock for peach, plum, almond, and apricot in cold or arid regions; hardy, blight-resistant pears; giant persimmons; a rapidly growing dry land elm; a hardy, cold-resistant bush cherry; the delicious litchi, a new fruit suited to Florida and California; and a host of beautiful ornamental trees, shrubs, and plants, such as the new Regal lily, the hardy Rosa hugonis, the white barked pine, and many others.

From Brazil has just come a new forage grass, Capim de Angola, more productive than the ordinary forms of Para grass grown in this country. This is already attracting the attention of some of our southern cattle growers on the Everglades of Florida.

The Amir of Afghanistan, most secluded of all monarchs, has sent the white mulberry tree, whose fruits are dried by his people and form a nutritious and valuable food, so valuable in fact that the trees are planted everywhere over the hillsides and the fruits gathered and dried by the ton.

India has given to our hemisphere one of the best of all the fruits, the mango. She has sent the best of her hundreds of varieties and many of these have already fruited out and proven superior to any so far found in the Western Hemisphere. When once the North American public learns how delicious these grafted mango fruits are, a great trade is sure to spring up.

The West Indian Islands have furnished the dasheen, a close relative of the Pacific Islands taro, which for many years has been a staple root crop there, and it is being successfully grown in our southern States.

The Dutch East Indies has supplied that most delicious of all tropical fruits, the mangosteen, the acclimatization of which in the American Tropics has just begun, and for which weak-rooted tree all the related species should be gathered together and used as stocks.

Although most of the fruit trees of the Annona class are already inhabitants of our western world, the best varieties have been so scattered that it has been hard for anyone to tell which to plant. We have gathered as many of these forms together as we could get and have begun to breed and select them.

The plant introduction possibilities of any country are great, but the range of plants which can be grown in a region where cold weather never occurs is greater than in one where every few years scores of species are killed outright by the cold.

Nowhere in South or Central America is it what we North Americans call really cold. The temperatures which sometimes occur here in Washington would, if they visited the lands of our southern neighbors, scorch their forests and make them look as though some gigantic forest fire had passed over them, killing outright thousands of species. The coldest weather in Patagonia is almost the same as that of northern Florida and the Carolinas during their occasional cold waves, and the only area of this country where the high altitude plants of the Andes appear to thrive is in the cool coastal climate of California.

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The possibilities, therefore, of plant introduction in the great warm countries of this hemisphere are not limited strictly by the frost line, as they are in the cold northern parts of it. In the United States there are barely a few thousand square miles of frostless country, whereas in South and Central America there are millions of such square miles.

I have picked out a few of the useful plants with which the office I have the honor to represent is at the present time experimenting, and will pass their portraits before you in quick succession in order to show you some of the things which are waiting to be introduced into all the Americas and which when introduced will enrich them in one way or another.

The oriental persimmon is represented by hundreds of varieties and several species in both China and Japan, and it is there one of the most important fruits. Hundreds of thousands of trees have been set out in the United States, and its importance is beginning to be appreciated. The longer-lived, large-fruited Chinese forms we have just secured during the past nine years. Some of them bear fruits devoid of tannin, while still hard. Some when dried are as valuable as figs, and tons of them are conserved by the villagers of the Shantung and other Provinces of China. The tropical forms of the Orient have not yet been properly studied, but when they are they will no doubt prove promising possibilities for South and Central America.

The deserts of the Old World have been utilized for centuries by extensive plantations of the date palm, and the experiments of the United States Department of Agriculture, begun in 1898 in Arizona and California, prove that the hottest deserts of the Western Hemisphere, if capable of irrigation, can be filled with these remarkably prolific fruit-bearing trees, which are adapted, as few others are, to extreme heat and a high degree of alkali in the soil.

The Chinese and Japanese timber bamboos are very different things from any of the South American bamboo species. They produce much more valuable woods, which can be used for the manufacture of much more delicate articles of furniture and basketware. They do not remain as clumps, but form extensive forests stretching for miles over the hillsides, and in addition to preventing erosion by means of their underground rhizomes, they produce the most beautiful of all landscape effects. Their young shoots are among the most delicate of all vegetables. In the United States both the shoot-bearing and the timber species are succeeding on an experimental scale.

The dasheen is already known in the West Indies and elsewhere in South America, but the varieties of this species differ much in excellence of flavor. The best out of a hundred or more varieties which we have selected is worthy of being called to the attention of those whose lands are moist and rich enough to grow them. The Pacific Islands have varieties which before they become extinct deserve trial in South and Central America.

We have canvassed the world for alfalfas and introduced over 1,000 strains or varieties for trial, including the Siberian and Turkestan hardy forms, a Peruvian and an Arabian variety for irrigated lands. Of forage grasses suited to all the Americas, there are probably a host of yet unexploited species; two, at least, however, have been sufficiently successful in this country to merit the attention of other countries. The Sudan grass for dry lands has had a phenomenal success in our Southwest, reaching as far north as the Canadian line on the Pacific coast, and the Rhodes grass from South Africa has shown itself peculiarly adapted to the subtropical conditions of our Gulf States. Stock eat them both greedily, and they are almost, if not quite, as nutritious as timothy, the standard hay producer in this country.

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The tung or wood-oil tree (*Aleurites fordii*) from the Yangtse Valley, which yields a very valuable drying oil, used extensively in varnish and paint manufacture, is growing successfully in small orchards in our Southern States. A south Chinese form (*A. montana*) and a strictly tropical species (*A. moluccana*) can both doubtless be cultivated in many portions of South and Central America, although too tender for any of our territory except Porto Rico and Hawaii.

The oriental mangoes from British India surpass in flavor, size, and freedom from fiber any of the mangoes of the Western Hemisphere; in fact, it could almost be said until a comparatively short time ago that there were no good mangoes on our side of the world. Mango orchards have begun to be planted in Florida, Hawaii, and Porto Rico, and when some of the problems of productivity have been solved, the mangoes will doubtless be planted on a commercial scale. It is certain that South and Central America should be testing out these oriental varieties.

The mangosteen, notwithstanding the fact that it is one of the sprightly flavored fruits of the Tropics and a great favorite in the Dutch East Indies, has never been properly studied by horticulturists. It has a poor root system and needs a new stock, which is not so particular with regard to soil conditions. It is only one of a large genus of fruit plants, the fruits of most of which have not even yet been tasted by civilized people. Some of these should find a home in the Tropics of the Western World, and a large trade in the mangosteen would certainly be the result.

It has been a strange experience to watch the progress made in this country by a little green fruit from Uruguay and Paraguay, called the feijoa (*Feijoa sellowiana*). Unexpectedly it has shown itself to be hardy in the Gulf States of this country, and the plant has proved in many respects an ideal dooryard shrub, furnishing one of the most aromatic fruits known.

A new industry to the Western Hemisphere, although centuries old in China, is the tsao or Chinese jujube. This jujube tree is related to the Brazilian jua, which is found in the State of Bahia, but is far superior to it, being represented by large fruited varieties of delicate flavor, both when eaten fresh and particularly as prepared fruits. Plants are being propagated, and many thousands will be sent to experimenters in this country next year.

There are so many species of the family to which the cherimoya belongs, and they are such delicious fruits, and it has been shown that they can be crossed and hybridized so readily that it would seem as though a great field for the improvement of this class of fruits were opening, and collections of the rollinia, the araticum, the ilama, as well as varieties of the cherimoya, sugar-apple, soursop, etc., have been gotten together by the United States Department of Agriculture.

In Java and the Philippines there is another new fruit which I can not refrain from mentioning, because it is such a delicious one and appears to have almost completely escaped the attention of horticulturists in the western Tropics. It is the doekoe or langsat (*Lansium domesticum*). Its straw-colored fruits should ship well, and its distinctly characteristic flavor appeals to the palate of those unaccustomed to the aromatic flavors of many tropical fruits.

Did time and your patience permit I could throw upon the screen in quick succession pictures illustrating scores of less well studied out plant possibilities which are open to us and which in the course of time will no doubt be worked out somewhere on this side of the world and result in industries which will feed millions of people.

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Much of commerce is an exchange of plant products. We have little conception of the gigantic commerce which is beginning now to flow back and forth from north and south over the oceans of this hemisphere. The northern-grown fruits and grain products will fill the steamers going south, whereas the tropical fruits and multitudinous plant productions of the Tropics will fill the holds of the northbound vessels, and every new plant culture, whether it develops in the northern or the southern continents will add its share to this great commerce of the future.

With the establishment in each country of South America of Government plant introduction and quarantine services, which should be closely associated and work together to keep out undesirable plant and insect pests of all kinds and at the same time bring in the useful plants, there will grow up an exchange between these Governments and that of the United States of the thousands of food and other economic plants upon which great new industries will be built.

The exchange of plants has already begun, and in some of the South American countries services are being built up, but their full importance has not yet been sufficiently recognized by their respective Governments. Over 4,000 shipments of plants and seeds were made last year, mainly to the officials of foreign countries, by the Office of Seed and Plant Introduction of the United States Department of Agriculture, and many of these were in exchange for similar courtesies shown this Government by these foreign officials. The way is open, therefore, for such friendly interchange of food plants, and all that is needed to make it one of the great factors of friendly cooperation is to recognize the importance of it and organize in each country the Government machinery to build it up.

Plant breeding is a factor in agriculture which is destined to play a gigantic rôle in the production of all classes of plant raw products, and its era is just beginning. The materials for breeders are scattered all over the world, and unless there is some machinery to collect them and aid the breeder to breed them some of the greatest accomplishments of plant production will be indefinitely postponed.

About 14 years ago in the small yard of the late Prof. William Saunders, of Ottawa, Canada, a handful of wheat from Calcutta was planted. One of these Calcutta plants was crossed on a Red Fife wheat plant, and out of this mingling of the protoplasms of an East Indian with a Canadian variety came not a wheat for more temperate regions but on the contrary a wheat which will grow farther north because it matures in 10 days less time. I rode this summer through hundreds of miles of fields of this Marquis wheat, a new and superior variety, which is already beginning to earn many millions of dollars a year for the Canadian wheat growers. Such work as this is beginning to be done in many parts of the world, and its possibilities, though slow to materialize, are so great potentially that every effort should be made to encourage it on a grand scale. There should be thousands of plant breeders at work on all of our cultivated crops trying in every way possible to combine and incorporate into them new and valuable characters found now in wild forms. The establishment in each country of Government institutions of plant introduction should do this great service, and not only gather for the plant breeders of each country the plants which are to be crossed, but give to the resulting hybrids and crosses the widest possible trial in the country of their origin and in foreign lands as well.

Lest there lurk in the minds of some the thought that this free exchange of plant varieties might impoverish the growers who originate the variety and enrich others in a foreign country, it may be well to point out the difficulties which the best organized corporations encounter to keep secret even their

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chemical processes and the futility of all attempts which have ever been made to prevent a desirable plant variety which forms the basis of an industry from becoming the common property of the cultivators of the world. This futility is apparent to all intelligent cultivators; in fact, it is almost inconceivable that an industry of any large number of growing plants could be so guarded that a traveler to the region could not secure so much as a single cutting or a single seed from which in a brief time millions of individuals could be propagated. Agricultural monopolies must be of another character, such as some superiority of flavor or other quality produced by the peculiar natural conditions of the place in which the plant is grown. Let us recognize, then, that we have these plants to give away; that they may be gigantic gifts from one country to another; and that their exchange should not be left to chance.

## HOW AN ANIMAL GROWS.

By H. J. WATERS,

*President Kansas State Agricultural College.*

In a mining enterprise a stage of development is soon reached in which ways must be devised for working lower grade ores. In every successful manufacturing enterprise the constant effort is to utilize the waste.

We have reached the stage in our agricultural development when we are seeking to devise ways of farming low-grade soils or farming in regions with unpropitious climates. Similarly, we are trying to make good meat out of low-grade feed and under conditions which we have hitherto considered to be unfavorable to domestic animals.

A necessary prerequisite to success in such an undertaking is a knowledge of how the animal grows; under what conditions it may attain normal development; and what factors other than heredity affect size, form, and functional capacity.

The controversy is age-old between those who breed the animals and those who feed them through the period of their development as to who bears the larger responsibility for their size, their form, and their functional activities when mature.

In general, it has been assumed that both have contributed in an important way to the final result, and likewise that within certain, though very faintly defined, limits the extra activities or intelligence of the one might easily compensate for or overcome the laxity of effort or the blunders of the other.

This notion implies that the feeder, for example, might by correct methods counteract or overcome to a considerable extent the mistakes of the breeder and make a good animal or a good race of animals in spite of poor mating. It also implies that if the animals are properly bred they will turn out well, even though not fed with the highest degree of skill or with the greatest intelligence, and that the quality would be maintained under poor feeding for many generations.

Lying at the foundation of progress in animal production is a clearer knowledge than we now possess of the limitations of heredity and nutrition in their influence upon the animal when mature and a definite knowledge as to whether the deficiencies of one may to any practical degree be supplied by the other. Such knowledge would immediately lead to a more definite division of the responsibility of those who breed the animals and of those who subsequently

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feed them. It does not matter that the breeder and the feeder are in many instances one and the same person. These are separate and independent operations, requiring for their most intelligent performance an exact kowledge of what is to be accomplished and of what part each operation plays in the final outcome. With this knowledge, we should have much less waste of effort through attempts to accomplish with feed those things which may alone be accomplished through breeding and by trusting to pedigree those things for which feed alone is responsible.

Undoubtedly the size an animal attains within the limits fixed by heredity is determined by nutrition. We know that an animal by growing at the maximum rate fixed by heredity until fully grown will attain the maximum size. But it does not follow, as has been assumed by many, that this is the only way in which an animal may even approximate normal size.

The view that an animal has only a single and a hard-and-fast way of attaining normal size, and that this way presupposes an ample and suitable food supply every day from the beginning to the end of the period of growth, is contrary to our knowledge of biology. We know, for example, that the animal organism has not reached its present state of development by so well commissaried a route. Any race of plants or animals which did not possess the power to get along and to attain full size under any except the most favorable conditions of nourishment which nature afforded would have perished long ago.

We know that the animal has several ways of reaching normal size, and we know that in farm practice reliance is usually not placed upon any single way of attaining this end. The law of physiological compensation seems to apply with special force in the matter of growth of animals.

We now have reason to believe that in attaining its stature and size the animal has recourse to any or all of the following means:

First. By growing steadily and at the maximum rate until mature, as with a uniform and adequate food supply.

Second. By prolonging the period of growth beyond that which is normally required to reach complete maturity, thus making up in time what was lost in rate. Of course, there is a limit beyond which this modification of the ordinary process of growth may not go. Experiments conducted at the Missouri and Kansas stations show that, within limits, development and maturity are more matters of nutrition than of age. A 12-month-old calf, for example, fed to the limit of the herdsman's skill will be more mature in muscle tissue, as measured by the relative diameter of the fibers and the composition of the lean meat, than a similar animal 24 months of age which has been sustained on a low nutritive plane. The bones of the highly nourished calf will be more mature than are those of the meagerly fed animal, as indicated by their size, composition, and structure.

Within limits, which have not been determined, the tissues of animals on a low plane of nutrition appear to fail to mature, and consequently are capable of making growth after the time when, under a more liberal system of nourishment, the tissue would have become mature and incapable of further development.

Eckles[1] has shown that liberally fed dairy heifers attained sexual maturity at between 8 and 9 months of age, while similar heifers sparingly fed matured sexually at from 12 and 13 months of age. Thus, sexual maturity was delayed nearly 50 per cent on the average by sparse feeding, reckoning from birth. The extreme range in individuals was from 5¾ months under heavy feeding to 16¾ months under sparse nourishment.

[1] Missouri Experiment Station, Bulletin No. 135.

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We have reason to believe that the skeleton reaches full maturity first and the muscle tissue next. The fat cells may retain their powers of generation and development long after the animal is fully mature as far as its capacity to increase in skeletal or muscle tissue is concerned.

Third. The fact that tissues remain young, so to speak, during periods of sparse nourishment gives the animals another, and in farm practice a very important, means of overcoming the effects of retarded development in its capacity to consume relatively large quantities of food and make for a time a very rapid gain.

In experiments made by the writer both at Missouri and at Kansas with animals which had been held at maintenance for from 6 to 12 months and then given all the feed they would eat, the rate of feed consumption and the rate of gain were out of all proportion to those of other animals similarly bred and of the same age, but which had been fed liberally from the beginning. For example, a steer which had been retarded consumed for a while more than 80 pounds of grain and a corresponding amount of hay per 1,000 pounds of live weight, while steers which had been liberally fed from the beginning consumed only 15 pounds of grain per 1,000 pounds of live weight.

The gain in live weight of the previously retarded steer was as high as 5 pounds a day for a time, while the rate of gain of the well-developed animals was from 2 to 2½ pounds a day.

Fourth. The growth of certain parts of the body continues after the growth of other parts of the body has ceased. Thus, the growth process appears to be more deep-seated and more difficult to check in some organs and parts of the body than in others. The results of experiments at Missouri showed that in height growth in young cattle, when fed a starving ration following a period of liberal nourishment, there was no appreciable diminution of the rate of increase. In a word, animals subsisting on a ration which was insufficient to maintain body weight and on which they were slowly starving maintained as rapid height growth for 60 days or 80 days as animals of similar breeding, age, and previous treatment which were receiving all the nourishing food they would eat.

In another experiment a steer was alternately fed all it would eat, and only so much was required to maintain body weight. For the first 30 to 60 days of each period there was no difference observable in the rate of height growth as between feeding to the limit of the appetite and feeding only for the maintenance of body weight.

The results of a chemical analysis of the bodies of the animals which increased in height while on a starving ration when compared with the composition of the bodies of animals which were slaughtered at the beginning of the experiment and which may be assumed to represent the composition of the bodies of animals which were slaughtered at the beginning of the experiment, and which may be assumed to express the composition of the experimental animals at the beginning of theperiod of low feeding show that eight months old steers,[1] when fed for six months so as to lose approximately one-half a pound in live weight daily, showed an increase in weight of skeleton and in total ash and total phosphorus of the skeleton. Similar steers fed for six months on a ration sufficient to maintain body weight showed the same result but not appreciably greater gains in skeleton.

Jackson[2] found in a later study of young albino rats (*mus norvegicus albinus*) that certain organs gained in weight, others remained stationary, and others

[1] Missouri Experiment Station. Unpublished results.

[2] Changes in the Relative Weights of the Various Parts, Systems, and Organs of Young Albino Rats Held at Constant Body Weight by Underfeeding for Various Periods. By C. M. Jackson, Institute of Anatomy, University of Minnesota. Journal of Experimental Zoology, v. 19, No. 2, Aug., 1915.

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lost in weight under a system of nourishment in which a stationary body weight was maintained by restricting the amount of food. Dr. Jackson divided the viscera into three groups with respect to the changes which occurred in their weights as follows:

Group 1 shows the organs with marked growth tendency to be the skeleton, eyeballs, spinal cord, alimentary canal, testes, hypophysis, and suprarenal glands. Group 2, which approximately maintains constant weight, includes the musculature, brain, heart, kidneys, and liver. Group 3, those which fail to maintain their weight when the body weight is held constant, includes the integument, lungs, thyroid gland, ovaries, spleen, and thymus.

Dr. Jackson adds:

Thus, on the low plane of nutrition in the young body maintained at constant weight, the growth capacity appears weakest in the skin and strongest in the skeletal system. This is in striking contrast with the normal growth process of corresponding ages, during which the musculature increases with relatively great rapidity and the skeleton lags behind relatively. The increase in the skeleton during constant body-weight appears to involve the ligaments as well as the cartilages and bones. The skeletal growth tends to proceed along the lines of normal development, as indicated by decrease in the water content, and by formation and union of varius epiphyses. Another evidence of the tendency to normal development of the skeleton is seen in the increased relative length of the tail as compared with the body length. The teeth also continue to develop normally.

In the case already referred to of the cattle fed at the Missouri Experiment Station on a submaintenance ration, and in which there was a gain in length of leg and depth of body, it is believed that the feed contained more available mineral matter than was necessary to maintain the ash balance on the basis of a stationary body weight and perhaps more available protein than was required to restore the waste of body tissue.

It is to be observed also that the animals at the beginning of the period of low feeding had stored on their body considerable fat as the result of a preliminary period of liberal nourishment.

It is conceivable that this fat helped in the growth process by supplying a part of the energy required by the animal over and above that supplied by the carbohydrates of the feed and thus protecting the proteins of the food in part at least and allowing them to be used for the purposes of growth.

We are accustomed to think of body fat as a source of energy for use alone in protecting the life of the animal by being drawn upon to maintain the normal temperature of the body when the food supply fails; to furnish the energy for work when it is necessary to travel long distances to find a new food supply, or a new water hole, but we have not yet considered fat in the light of a protection also of the process of growth. We know that the animal without the safeguard of stored fat would be as helpless as a plant upon a soil without power to hold water or as a plant robbed of its capacity to store food in its root stock or bulbs with which to sustain growth under conditions which are not favorable for drawing upon the elements of the soil and the air.

It is believed that if we deprived the animal of its power to protect the growth process by means of fat stored in times when food is abundant we should be depriving it of one of its important means of attaining normal size under conditions of intermittent food supply.

Fifth. By conserving the cost. The results of our investigations show a marked and uniform decline in the amount of food required to maintain body weight in the case of animals kept for a long time on a low nutritive plane as compared with the maintenance cost of these animals closely following a

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period of liberal feeding. For example, when we reduced the feed of an animal which had been previously liberally nourished to a point where for a month or more there was a slight loss in body weight, an equilibrium was later established, and still later the animal increased in weight, the quantity and quality of the food remaining constant. Thus a ration that was insufficient to sustain live weight at first was capable later of maintaining the body weight and still later of causing an increase in weight. Apparently the animal was able finally to grow on an amount of food which following a period of liberal nourishment was incapable of sustaining body weight. For example, in a thousand-pound steer 11.95 pounds of dry matter was required to maintain body weight immediately following a long period of heavy feeding, and 7.7 pounds of dry matter from the same kind of food was sufficient for this purpose after the animal had been on maintenance four months.

Jackson [1] found the same to be true of albino rats. He was able to maintain stationary weight on approximately 3 grams of feed after seven weeks of sparse feeding, whereas 5 grams of feed had been required at the beginning of the period. The results of a number of digestion trials indicate that a part of this economy is effected through the more complete digestion of the feed.

For example, the average coefficients of digestion were: [2]

| How fed. | Total dry matter digested. | Protein digested. | Nitrogen-free extract digested. | Crude fiber digested. | Ether extract digested. |
|---|---|---|---|---|---|
| Full fed [1] | 71.28 | 66.65 | 77.89 | 42.21 | 77.89 |
| Moderately fed [2] | 75.63 | 70.15 | 83.69 | 40.30 | 76.64 |
| Low plane [3] | 77.49 | 75.01 | 85.14 | 40.46 | 79.63 |
| Maintenance [4] | 82.91 | 76.58 | 90.54 | 47.99 | 83.48 |

[1] Fed to the limit of the appetite.
[2] Fed so as to grow but not to fatten.
[3] Fed so as to gain very slowly; about one-fourth of a pound a day.
[4] Fed so as to maintain stationary body weight.

A part of the difference appears to be due to changes in the temperament of the animal. The first effect of changing from liberal to sparse nourishment is to increase the nervous energy wasted in running about bawling and seeking the means with which to satisfy hunger. But later the animal becomes adjusted to the low plane of nourishment, and except in cold weather it remains very much more quiet than it did even when amply fed. The largest economy, I believe, is to be found here, but unfortunately, under range and farm conditions, advantage could not be taken of this law, as the animal would be likely to put forth greater effort to find food when it was scarce than when it was abundant.

### PERMANENT STUNTING.

If retardation is carried too far or made to extend over too long a period, the animal loses its power to overcome the loss sustained, and permanent stunting has been effected. Just where this point is reached we do not know.

In our work with cattle it has been found that the recovery may not be complete if the period of retardation is made to extend beyond that of two or three months, but there is evidence to indicate that a period of checked or

[1] Changes in the Relative Weights of the Various Parts, Systems, and Organs of Young Albino Rats Held at Constant Body Weight by Underfeeding for Various Periods. C. M. Jackson, Institute of Anatomy, University of Minnesota. Journal of Experimental Zoology, v. 19, No. 2, Aug., 15.

[2] Adapted from Missouri Agricultural Experiment Station, Research Bulletin No. 18.

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delayed development greater than this and corresponding to that which frequently occurs on the farm or range from a shortage of pasturage in dry seasons or an insufficient supply of feed in winter may not affect substantially the size, form, or value of the beef steer for market purposes. This, of course, presupposes that following such a period of sparse nourishment there be provided the opportunity through an abundance of pasturage or other feed to make up for the loss sustained during the period of sparse nourishment.

We have had several cases in which steers which had been held on restricted rations for long periods of time, as much as four years in some instances, had apparently lost their power to utilize large amounts of feed and to make rapid growth or to store fat. We now have at the Kansas station two such steers which have been fed to the limit of their appetites for eight months with very little change in body weight. These animals are consuming only slightly more than maintenance food, although they are given all they will eat.

I am inclined to attribute this result to some incidental cause, however, as it is well known that cattle which have been kept until 6 years of age or older under conditions of very limited food supply on the range, will fatten rapidly when liberally fed.

### THE RELATION OF NUTRITION TO FORM.

It is most interesting to observe that in all our experiments the development of cattle which were sparsely fed was not in the same proportion with respect to certain of the parts of the body as was the development of cattle abundantly nourished. The sparsely fed animals grew relatively more in height than in width. Also, in width of chest or the transverse diameter of the chest, there was relatively much less increase in the animal sustained on a low nutrition plane than in those fed on a high nutritive plane. The increase in width of hip relative to the increase in height and relative to the increase in length of leg was much less in the case of the sparsely fed animals than in those which were liberally fed. In the case of animals fed on a starving ration, as well as those receiving a ration only capable of sustaining body weight or of making a very slightly gain, the increase in height persisted much longer than did the increase in width. Thus, the effect of long-sustained low nourishment is to produce an animal that more nearly approaches the normal in height than in width.

The effect of any considerable period of retarded development is very apt to be to refine the skeleton in the mature animal, for the reason already given that the skeleton matures relatively early in the life of the animal. The effect is also to produce a smooth, well-rounded, but somewhat narrow buttock.

The effect of heavy feeding through the entire growth period or for a long time, beginning when the animal is young and when the skeleton is plastic, is to make a large-boned, coarse-jointed, wide animal.

In skeletal covering the effect of a prolonged period of sparse feeding may have a more marked effect, principally because of the smaller diameter and shorter length of the muscle fibers. There is no reason to believe that the capacity of the animal to fatten is altered by such periods of starving as were used in our experiments.

### REPRODUCTION A MODIFYING FACTOR.

In the discussion thus far we have dealt with unsexed animals and have disregarded the influence of reproduction upon growth.

Deep seated and fundamental, as the growth process has been shown to be, it is not to be compared in this respect with the process of reproduction. There-



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fore, when there is not sufficient food to sustain growth and to fulfill the requirements of reproduction, growth is the first to suffer and is completely checked before the process of reproduction is seriously interfered with.

This has been very clearly brought out in experiments with dairy cows at Missouri by Eckles,[1] and is unmistakably shown by the results of investigations by Prof. Reed now in progress at the Kansas Experiment Station.

Thus, when the young ungrown female is required to maintain the growth of a fœtus, as well as to sustain growth in her own body, she must have more feed than would be needed for only one body. When the nourishment needed for both is not supplied, the growth of her body is the first to suffer.

After the young is born the demand upon the body of the mother to nourish the young is greater in many species than it is during the period of fœtal development. This is especially true of females in which the tendency to produce milk has been highly developed as in the dairy cow, or when the demands of the young for food is large because of the large number of the young, as in the case of the improved races of swine. In such cases even under conditions of the most liberal feeding following partutition the mother has not the opportunity that the unsexed animal, such as the steer or barrow or gelding has, to make up in rate of growth what was lost in time. As a consequence, females required to reproduce early in life, even when liberally fed, are generally undersized. The same law applies equally to the male, provided the reproductive process is sufficient in extent to become a tax upon the organism.

### THE EFFECT OF NUTRITION ON INTELLIGENCE.

Wholly incidental but of much interest and importance is the observation that whenever the nourishment of the young animals was restricted, either in amount or quality, there was an unmistakable and striking evidence of a retarded development of the intelligence.

Calves when fed sparsely never learned to go into their own stalls or to go on the scales to be weighed, or to stand quietly to be measured or to have their photographs taken. Similar animals abundantly nourished quickly learned to go to their own stalls, and easily fell into the daily routine of weight taking and the like.

In another experiment conducted by the writer with pigs in which the amount of the feed was unrestricted, but in which the nutritive value of the feed was low, the same phenomena were observed. There was without exception a general indication of stupidity and preverseness in all the animals which were poorly nourished. In several instances where we later fed such animals liberally they quickly learned the daily routine and became quite as tractable as those which had been abundantly nourished all along.

### MEANS OF OVERCOMING THE TENDENCY TO REVERT.

Reversion is one of the most constant tendencies of domestic animals. The tendency is more marked and active the more highly developed or improved the animal is. Reversion is favored by conditions that are unfavorable to development, such as scarcity of feed and exposure. All of our domestic animals have been highly specialized, and in their present form and functional activities represent a large departure from ancestral types. In some races this development has been in the direction of their capacity to convert large quantities of feed into milk and butter, as in dairy animals. In others

[1] Research Bulletin No. 135, Missouri Experiment Station.

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the deviation has been in the direction of a capacity to lay eggs for a long period of time. In some of our races of domesticated fowls the instinct to sit as soon as a setting of eggs has been laid seems to have been lost. In other species the artificiality is with respect to performing certain functions, as is illustrated by the tendency of pointer and setter dogs to hunt birds and of the shepherd dog to drive stock.

In some races it is an intensified capacity to utilize large quantities of feed for the rapid production of body tissue, and especially for the storing of body fat in an early period of life and at seasons of the year which in nature is abnormal. Such is the modern beef animal and with these functional changes have come change in form, the most striking of which are a relative diminution in the length of leg, a very large increase in thickness of flesh covering, a relative decline in size of the head, and a striking widening of the body relative to its height.

Reversion is but another expression of the adaptation of an animal to its surroundings. It must either adapt itself to its environment or perish. If the food supply is insufficient to maintain the size, the stature must be reduced to correspond to the food supply. A highly developed race of beef animals, if put on the range, and with an intermittent and inadequate food supply, will revert toward the ancestral type much more rapidly than will the same race under conditions of uniform and ample nourishment. The ancestral type toward which reversion will carry the improved beef animal is narrow-chested, thin, narrow-hipped, long-legged, and sloping crouped.

In a general way we say that conditions of feeding, breeding, and care which were required to produce a type of a given degree of excellence are required to maintain such type or excellence.

Perhaps this is true in the large, but it is clear from what the stockman has done under range conditions by better breeding alone and without modifying the conditions of nourishment, that great and substantial improvement may be made in the size, the form, and quality of cattle, sheep, goats, and horses.

Recently I saw beef cattle of splendid type on the range which under a system of natural selection the Texas long horn and the Mexican sunfish type were produced and maintained.

To be certain that a part of the superiority of the cattle was not due to the better care and better management of the pastures, I was interested in studying the type of the wild hogs, descendants from improved domestic stock, which had run wild and were shifting for themselves. In size, form, and thickness of flesh these hogs were vastly superior to the type which poor feed and natural selection combined have produced.

In a word, by raising the inheritance through intelligent breeding, we may do much to offset the dwarfing effects of sparse and intermittent feed supply or the ill effects of using feeds of low nutritive value.

Some have suggested that we are approaching a time when we shall not need the specialized beef animal, and that henceforth we should be satisfied with animals which only approximate in excellence those which have been developed under an abundance of rich grass and nutritious grain. Such a theory ignores the greater need that we shall have for superior inheritance to offset in part the steadily lowering standards of nutrition through the increased use of cheaper food materials.

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## SECURING SETTLERS FOR PRIVATE IRRIGATION PROJECTS.

By H. G. SHEDD,

*Secretary Shedd Investment Co., Omaha, Nebr.*

The year 1890 may well be taken as approximately the end of our Government's wonderful gift of free homes to its people. In ever-increasing volume, from the arrival of the first settlers on the shores of Virginia and New England, the tide of population each decade swept farther and farther westward, rapidly filling the fertile prairies that stretch from the Alleghenies to the Rocky Mountains, until, with the opening to settlement of the Oklahoma country, the last great body of free Government land was occupied.

As President Wilson says in the last chapter of his History of the American People:

> The new age of growth which had followed the war showed a quickened pace of change. * * * Thoughtful men perceived how significant a thing it was that but five territories remained in all the broad continent, with scattered reservations here and there in the farther West, set apart for the red man. In 1889 the Government had purchased of the tribes even a part of the Indian Territory which lay within the circle of Kansas, Arkansas, and Texas, to be thrown open to white settlers—the fairest portion of it, Oklahoma, the beautiful land which lay almost at its heart; and all the country had heard how mad a rush there had been across its borders to secure its coveted acres. A host of settlers 50,000 strong had encamped upon its very boundary lines to await the signal to go in and take possession. At noon on the 22d of April, 1889, at the sound of a bugle blown to mark the hour set by the President's proclamation, the waiting multitude surged madly in, and the Territory was peopled in a single day. It was the old, familiar process of first occupation and settlement carried out as if in a play, the story of the Nation's making in a brief epitome. Its suddenness, its resistless movement of excited men marked in dramatic fashion the end of the day of settlement. The best parts of the continent, save isolated reservations here and there, were taken up; and the stream of population was dammed at their borders only by the barriers of law. When they were removed it would spring forward like a flood.[1]

With the virtual end of the free Government lands, so graphically described by President Wilson, the never-ending stream of population seeking new homes spread out over the great bodies of privately owned lands, possessing itself of the great ranches of central and western Texas, of thousands of acres held by the land-grant railways of Kansas, Nebraska, and the northern prairie States, and even of the wide expanse of our northern neighbor's fertile wheat lands. Under this condition of lessening areas susceptible to settlement and correspondingly rapid increase in values, attention turned to the rich valleys of the western mountain States, where thousands of acres of wild but fertile lands awaited only the proper application of water by irrigation to furnish homes for many families. The years from 1895 to 1910 witnessed the inception and completion of many irrigation systems of varying size. The success of earlier efforts in the older portions of Colorado, Utah, and California, the provisions of the Carey Act, and the entrance of the Government into active reclamation of large tracts of arid lands stimulated private capital to similar reclamation of large bodies of State or privately owned lands susceptible to irrigation.

In the sale and settlement of large privately owned bodies of arable land in the prairie States and western Canada after 1900, special agencies for directing the people to new districts had sprung up. Railroads holding land

[1] Woodrow Wilson, History of the American People, vol. 5, p. 210. Harper & Bros., New York, 1907.

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grants or desiring quickly to fill sparsely settled districts reached by new lines instituted colonization departments and carried on systematic campaigns of advertising the opportunities awaiting the new homeseeker. Colonization companies representing large private holdings worked to a similar purpose, gathering men together at central points and transporting them by carloads and even trainloads to the new districts. Selling campaigns, systematic, energetic and of great magnitude, were carried on for several years, and thousands of families were located on the hitherto almost limitless prairie.

The large private irrigation companies quickly realized the necessity of rapid colonization and almost from the beginning followed the same plan of directing attention to their particular sections of the West. To the management of such projects, rapid sale of land and water rights on terms insuring payment of interest and bonds, as well as maintenance cost of the property, is essential. The necessary higher price of irrigated lands, owing to heavy construction cost, as compared with semiarid districts where lands are still being settled upon, the ignorance of and often the prejudice of the great mass of farmers in the Central and Eastern States toward methods of farming under irrigation, and often the distance of these western irrigated districts from the more populous States east of the Missouri River, taken with the financial necessity of quick and certain sales, all combined to place the settlement of lands under private irrigation systems largely in the hands of trained colonization companies, which through their perfected organization of agents throughout the Central and Eastern States quickly could interest prospective homeseekers in intensive farming in the fertile mountain districts of the West.

In the beginning these companies employed much the same methods in selling irrigated lands as had been used in the disposal of the cheaper prairie areas. Extensive advertising campaigns were inaugurated. Attractive folders and booklets, often handsomely illustrated, were mailed to thousands of farmers and business and professional men. The recipient was urged to write direct to the selling company for detailed information about the particular merits of the advertised lands and to send in the names of friends and relatives who might be interested in the investment offered. Thus was secured an endless chain of prospective investors, who were soon literally bombarded with all the ammunition of the most ingenious follow-up systems known to business.

Glowing letters descriptive of the many wonderful opportunities to be found in the new district were mailed regularly. Heavy crop yields, profitable marketing operations, the constant arrival of new settlers, and the steady growth of the new community, and especially the sure and rapid advance in land values taking place, were vividly emphasized. Special appeals were made to each class of purchaser—to the farmer who had just sold his high-priced eastern land and desired a larger acreage of equally fertile land at a lower price for his growing family; to the young tenant farmer who had saved enough to make a start on a farm of his own where the payments were spread over a long term of years and were little heavier than the annual cash rental paid for Iowa and Illinois farm land; to the professional or business man who had surplus money seeking investment and who, perhaps, had seen farm land in his home district double and treble in value in a few short years. Every emotion was played upon, although the most prominent, of course, were the human desire to own a home and the equally human desire to make a profitable investment.

Not alone were attractive booklets and enthusiastic letters resorted to. More personal means were employed. Letters direct from satisfied settlers on

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the irrigated lands, or from men who had visited the tract and invested there, reached the prospective settler or investor. He was invited by the recently formed commercial club of the new district, by the farmers' club, by the principal of the schools, by the mayor of the flourishing young town, by the editor of the six weeks' old paper, and by the head of the brand-new bank to come out to this wonderful land of promise and join with them in the making of an empire. Personal work was also begun by the selling company's local agent, who generally was well acquainted with the prospect and knew much of his affairs. Others also were interested, and the local agent at once began to gather together a little party to visit the new irrigated tract in a body on one of the excursions conducted regularly by the selling company from central gateways such as Chicago, Kansas City, Omaha, and Denver. Assistance was rendered the local agent by field men and representatives of the colonization company, who would appear a few days before the excursion date and help in organizing the local party and arranging for the railway tickets and accommodations. To make certain of the party, it was usual for the local agent to visit all the interested persons early on the morning of the excursion, gather them into his automobile, and bring them to the train in a body. The sight of some of his neighbors ready to take the trip often determined some undecided one at the last moment. Arrived at some central point, the little group of men was merged with other small contingents from various localities into a jolly, good-natured party of hopeful American citizens en route to a modern El Dorado.

For several years the southern and western railways have placed on sale on the first and third Tuesdays of each month what are known as special homeseekers' round-trip fares, which are but little higher than the one-way rate. These reduced fares are widely advertised and generally known throughout the great agricultural States east of the Rocky Mountains. They are on sale to various points in the Gulf States in the south and westward to points beyond about the one hundredth meridian, which may almost be said to mark the western boundary of the thickly settled central portion of the United States. These cheap railway fares have been a potent factor in bringing thousands of new settlers to the semiarid and arid districts of the West.

The selling companies handling private irrigated tracts of land have naturally taken advantage of these special rates and have conducted their excursions on the selling dates of homeseekers' tickets. When the movement for western land was in full swing some years ago, many colonization companies conducted from one Pullman carload to a solid trainload of prospective settlers and investors every two weeks from Chicago, Kansas City, or Omaha. These excursions were organized much the same as any large private touring party. Constant thought and care were given to the comfort and pleasure of the travelers. Special sleeping and dining-car accommodations for the entire round trip were furnished. Long hours on the train were enlivened by music from a victrola or a specially selected quartet. Sight-seeing trips through the larger cities and to prominent points of interest in the mountains en route were provided. Where possible, an old and highly developed irrigation section, where intensive farming was practiced successfully and where values had reached a high point, was visited en route that a prophetic picture of the future of the company's newer project might be glimpsed. If the capital of the State, wherein was located the destination of the party, was visited, the governor often met the party in person and extended a cordial welcome on the part of his great Commonwealth.

Upon reaching the lands for sale, an inspection of the irrigation system—reservoirs, headgates, distributing canals, and laterals—was usually the first

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thing on the program. A representative of the irrigation company's engineering department generally accompanied the visitors to explain the construction features and the methods of storage and distribution of water for irrigation. Later special demonstration farms conducted by the company and the farms of the settlers who had taken up residence were visited, where crops were examined, actual irrigation of fields observed, and the farmers questioned closely. The first evening spent in the new community was often given over to a banquet of welcome carried out under the auspices of the local commercial club. The new arrivals were made to feel at home, to forget the black soil of the corn belt, and to see the possibilities of the gray sagebrush land. On the second day the principal object of the excursion began—the sale of the lands. This continued until all in the party had made definite decision for or against investment, when most of the visitors boarded an eastbound train for home and the new community quieted down until another party arrived a week or 10 days later. Enthusiasm, hopeful optimism, expectancy of great returns, the very spirit of new men taking up new tasks, caught and carried forward the majority of the visitors, who only too quickly decided to link their fortunes with those already on the scene.

Such in general was the method pursued by the companies selling lands under the large private irrigation systems in the West during the period of their most rapid sale and development, from 1904 to 1910 or 1911. It must be remembered that these years marked one of the many recurring onward waves of population rushing westward from the crowded Eastern and Central States. It was the time when thousands of sturdy American farmers were hurrying by trainloads across our northern border to the wheat lands of the western Canadian Provinces, when still other thousands were crowding into the Panhandle of Texas and as far south as the lower Rio Grande Valley. It was a period of expansion—a period when men's minds, emboldened by successful ventures and increasing wealth, were caught by the lure of distant opportunity. During this period there developed the "back to the land" movement in the cities. Great "land shows" and "agricultural congresses," illustrating the resources of the various agricultural districts of the West, were held, the primary purpose being to interest settlers and capital.

In such a period, under the methods employed to attract investors, it was natural that large areas of irrigable land under private projects should quickly be sold. Although no statistics are available, it is safe to say that the major portion of these purchasers came from Iowa, Illinois, Nebraska, and Kansas—perhaps in proportion in the order indicated. Proximity to the mountain States and the rapid increase in values of farm lands and general prosperity of the agricultural districts of these States from 1900 to 1910 undoubtedly account for this. Population still moves along nearly parallel lines, and broad parallel lines from these States diverging slightly southward and northward as they progress lead almost straight to the great irrigated sections of southern Montana, Wyoming, Colorado, New Mexico, Utah, Idaho, and California.

With the slowing down of the Nation's pulse following the year 1907 and a slackening of the movement of the people since 1910 a time of pause came in the sale of irrigated lands, and both the promoters of irrigation projects and colonization companies found time to study the effects of the previous feverish disposal of lands. It was found that the early appeal perhaps had been directed not so much to the actual home seeker and home builder, so greatly needed in the new sections, as to the investor and speculator seeking rapid and large rewards. Too often the exceedingly low initial payment and the apparently easy terms allowed on the balance of the purchase price, extending over

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from 5 to 10 years, blinded the purchaser to development expense, necessary maintenance cost levied against all irrigated lands, and accruing interest charges, with the result that too large areas were very frequently taken over by both settlers and nonresidents unable to carry through their contracts. Tenants for farms in newly developing and sparsely settled communities are few, and many nonresident holders of irrigated lands became discouraged by the impossibility of leasing their lands or by the poor returns where their land was developed, seeded, and irrigated and the crop harvested by contract. The irrigation companies soon found altogether too many nonresident owners becoming badly in arrears or their contracts being forfeited.

Many of those who went into residence on their holdings also had purchased too much land and too often had underestimated the cost of development and the slow process of building up a new farm to a high state of productiveness under entirely different ways of farming. In some localities seepage troubles developed, necessitating additional cost for drainage; in others water shortages occurred, bringing lean years and eager hopes unfulfilled. Disappointments incident to all new enterprizes had not been properly foreseen and discounted. Payments on contracts were hard to meet, and each year the accumulated arrears increased. Many settlers, especially those recently come from the cities, were unfitted for the hardships of pioneering in a new country and were gripped hard by lonesomeness and homesickness; too often these gave up the struggle and returned to their old homes or moved to other fields.

The very spirit of the Nation which had become one of slowing down, of retrenchment, almost of stagnation, weighted heavily upon the newer communities, which essentially live and thrive on enthusiasm and the rosy promise of the future. Many private irrigation companies passed into the hands of receivers. New systems partially underway stood still. Many in the forming passed from sight entirely. Irrigation bonds suffered and were looked upon askant by the eastern money markets. For five years private irrigation companies have been passing through a period of liquidation, of retrenchment, of adjustment, but withal a period of realignment of forces for bringing their projects into a proper and healthy growth and expansion.

Thoughtful persons interested in the future of these new communities have come to realize that the old methods of sale, taken from the earlier days of selling cheap lands in boom times, are not best adapted to the settlement of irrigated tracts, where intensive farming must be practiced to assure success. It might well seem as if too idealistic conditions had been pictured and not enough attention had been given to limiting the settler to the sized tract he could improve successfully according to his means. Too much emphasis had been placed on the speculative value of the lands and not enough on the necessity for actual settlement and actual improvement of the property. To-day it is generally realized that as a rule the mere nonresident investor in irrigated lands is a detriment to the upbuilding of the community and his contract a questionable asset on the books of the irrigation company. Progressive irrigation companies have come to see that their success is wrapped up in the prosperity of the men who are farming the lands under the irrigation systems they have built, and that a constructive community spirit of mutual cooperation is essential. The selling companies which are still colonizing irrigated lands have also learned the lesson and are doing their work along similar lines. Their appeal is now very largely to the actual homeseeker, the eastern farmer who is truly desirous of going into an irrigated section and building up a new home, the tenant farmer who has saved enough money to make a good start toward

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independence, the city dweller who is in dead earnest in his desire to get back to the land and has the mettle required to succeed in an entirely different environment. There is a more rigid investigation of the prospective purchaser's plans and financial resources, a more detailed explanation of costs to be met, of obstacles to be overcome, of approved methods of irrigation farming necessary for success. Smaller tracts of land, more intensive cultivation, more attention to stock raising and mixed farming are advocated. In general it can be said that while the campaign for settlers is carried on just as energetically and persistently as before, the work of the selling companies is characterized by greater accuracy of statement and a more educational spirit. The ultimate success of the farmer as well as the actual sale of the land is kept in mind, thereby assuring the complete fulfillment of the purchaser's contract as much as the securing of the initial cash payment and the mere signing of the papers.

In forwarding this plan of cooperation between the irrigation company and the settlers, resident irrigation managers interest themselves in various activities that point to the general welfare of the community. Encouragement and financial assistance are given to churches and religious societies, agricultural organizations, literary and athletic clubs, and popular amusements. On one large project in Colorado the company has erected and donated to the community a library building, a pretentious church edifice, a commodious hall for public meetings, amusements, and neighborhood gatherings, and 160 acres of land on which an efficient agricultural and industrial college is steadily growing. County agricultural agents appointed under the direction of the United States Government experiment station find the officers of irrigation companies alert to render them every assistance in their work. Company engineers assist new settlers in laying out their field laterals and show them how to apply the water to the best advantage. Mixed farming is encouraged and specialists are often brought to the community to demonstrate approved methods of dairying and poultry raising, the great sources of ready money to the farmer, the advantages of ensilage for winter feeding and the best construction of silos, the marketing of farm products, the selection of seed, the keeping of farm accounts.

Following the lead of the late James J. Hill in interesting the farmers along the Great Northern Railway in improved live stock, thoroughbred strains are introduced among the irrigation farmers. Sugar beets, seed potatoes, and new alfalfa seed especially suited to the particular district are obtained and the settlers urged to try out small patches as a demonstration of their merits. The producer is put in touch with the best markets, daily reports of which are often furnished by telephone from the irrigation company's office. In necessary construction work on canals, bridges, and buildings, preference is given the settler and his boys, thus placing considerable sums of money in circulation within the locality. Every possible means looking to the welfare and assistance of the settler and of building up a strong, virile, prosperous community is eagerly grasped by the progressive irrigation company to-day.

On some large projects with considerable areas of land available the community idea is being tried out in a somewhat different way. This is by setting aside particular portions of the tract to be colonized by families of distinct local affiliation or of particular religious creed. One large tract of irrigated land in Wyoming has been settled almost exclusively by families from adjoining Iowa neighborhoods. Another is being settled by German Mennonites from Kansas. A certain irrigated area in California is filled with members of the Danish Lutheran faith, while in southern Colorado several thousand acres are rapidly being taken by Seventh-day Adventists. These

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colonies are encouraged by liberal donations to be used for church and school purposes and are rendered every possible assistance looking to their ultimate success. It is realized that the prosperity of such colonists means the arrival of increasing numbers from their old home both in America and Europe.

On the Canadian Pacific Railway Co.'s immense Bow River project in southern Alberta are colonies made up almost exclusively of German-American farmers, of Danish-American farmers, and of experienced irrigation farmers from northern Colorado. The Canadian Pacific Railway Co. has even gone so far as to develop ready-made farms for settlers on its irrigated lands. On these farms the land has been plowed and fenced, buildings erected, well sunk, so that the farm is ready for the occupant to begin work upon his arrival. This plan has not appealed greatly however to the American farmer whose independent spirit no doubt prompts him to plan his own home and arrange his own farm according to his own fancy. To meet this objection the railway company has worked out a loan policy whereby the bona fide married settler who has made his initial payment, possesses money enough to support his family a year and sufficient live stock to go into occupation and proceed with the development of the land, may obtain a credit of not to exceed $2,000 to be expended upon farm improvements. The total amount of the advance is added to the price of the land and repayment of the same spread over 20 equal annual installments with interest at 6 per cent. It is understood that many large private irrigation companies in the United States as well as the Government Reclamation Service are watching this experiment with great interest.

The securing of settlers for private irrigation projects is therefore now carried on along different lines than in the boom days of land selling a decade ago. Advertising matter is more strictly accurate. The promise of reward is tempered by the necessity for hard work and courage in overcoming new conditions. Careful investigation of and preparation for the new venture are encouraged. The future of the settler is considered in relation to the future of the project. The spirit of mutual cooperation between settler and irrigation company is emphasized. Although the private irrigation lands are filling more slowly under these conditions, there is less of discouragement and more of promise for both the builders of the projects and the settlers who are developing them.

## Adjournment.

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## JOINT SESSION OF SUBSECTIONS 1 AND 3 OF SECTION III.

RALEIGH HOTEL,
*Tuesday morning, January 4, 1916.*

Chairman, N. C. GROVER.

The session was called to order at 9.30 o'clock by the chairman.

The CHAIRMAN. Before presenting Mr. Callbreath, the first speaker on the program, Mr. M. R. Campbell, of the Geological Survey, will say a few words introducing the general subject of discussion.

Mr. CAMPBELL. Interest in the conservation of the mineral resources of a nation depends largely upon the scantiness of the original supply and upon the stage of development and utilization that has been attained. As many of the Latin American States are more interested in having their mineral resources made available than in conserving the supply, it is difficult to select a subject of common interest for a Pan American theme, but the subject "The conservation of the mineral resources of a nation through Government ownership or control" is one that is of immediate importance to the United States and doubtless eventually will have to be considered by the other countries also.

The past policy of the United States has been to make the acquisition by the discoverer of the mineral lands of the nation as easy as possible so as to encourage prospectors in the search for and, when found, in the development of the deposits. Title to the mineral land was passed to the applicant with little formality and almost no compensation, and the result has been that the Government has recently awoke to the fact that the most valuable mineral lands have passed forever from its control. A change of policy is imminent, but whether the Government will continue to sell outright its mineral lands or to lease them and thus control the output has not been determined. The object in presenting this subject is to elicit discussion on this important question and an exchange of views as to the best policy to pursue.

The CHAIRMAN. I shall now call for the paper by Mr. Callbreath, "Government control of minerals on the public lands."



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## GOVERNMENT CONTROL OF MINERALS ON PUBLIC LANDS.

By JAMES F. CALLBREATH,

*Secretary of the American Mining Congress.*

The ownership of land and the liberties of humanity have ever been closely related. A home-owning people is a people of freedom and independence. The more centralized the ownership of lands the further from democracy.

Any discussion of the Government control and management of its minerals and mineral lands is so closely related to the general subject of public lands as to require for its proper understanding a historical review of the public-land policies of the United States under which the different regulations as applied to mineral lands were developed.

In the year 1847 the country west of the Mississippi River was a great unknown territory. Its only town of importance was Portland, then consisting of two frame houses and a few log cabins. Along the shore line a few hardy pioneers resided, mostly engaged in trapping and lumbering.

From the landing of the Pilgrims at Plymouth and the settlement of Jamestown over two centuries had elapsed. The Missouri River marked the extreme western border of civilization. During this period the scarcity of money retarded trade and made modern commerce impossible.

An almost unbroken line of wilderness presented its front to the Pacific from Puget Sound to Lower California. A quiet was over the face of nature more intense than the stillness which reigned in Bethlehem prior to the appearance of the Star of the East, from which dated the greatest era of the world's history.

But another era dawned. Over at Sutters Creek Jim Marshall's discovery of gold commanded the attention of the world.

It led to the peopling of California and the other coast States. It led to the discovery of gold in Colorado and other Rocky Mountain States. It made the trans-Mississippi empire. Not only was the West peopled by mining pioneers, but the result of the production of gold gave new life to the business of the East.

The growth of the United States as a world power began at Sutters Creek in 1848; a growth so rapid as to astonish the world. More than that, during the dark days of the Civil War, the gold of California and the silver of Nevada saved the Nation's credit, and played an important part in the preservation of the Union.

The original 13 States comprised approximately one-half billion acres of land. The total area of the United States, including its Alaskan and insular possessions, is 2,395,715,840 acres. The area of the United States, exclusive of Alaska and the insular possessions, is 1,937,144,960 acres within the States under the control and disposition of Congress. Of this amount there now remains about 290,000,000 acres unreserved and unappropriated, and about 160,000,000 acres in the forest reserves.

Practically four-fifths of the area of the United States was obtained at a cost to the Government of a trifle over $76,000,000. Since that time the Government has received for such of its lands as have been sold the sum of $474,477,393.81. In addition to having received an amount six times greater than the amount paid, large areas have been donated for military service and for educational purposes; more than 80,000,000 acres of land have been donated to railroad corporations to encourage railroad construction, and the Government still retains ownership of approximately 450,000,000 acres of land.

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This result by itself seems to be ample justification for the liberal land policies which have controlled during the greater part of the Nation's history. The most notable result, however, is the marvelous industrial growth which has obtained as a result of this liberal policy.

The first act of the United States Government having to do with minerals was the ordinance of May 20, 1785, for the disposal of lands in the western territory comprising what is now the States of Ohio, Illinois, Indiana, Michigan, and Wisconsin. One-seventh of this area was given to the soldiers of the Continental Army, one thirty-sixth set apart for the public schools, one-seventh reserved to the National Government, and the balance allotted to the several States to be sold at auction by the State land commission, but reserving to the United States "one third part of all gold, silver, lead, and copper mines to be sold or otherwise disposed of as Congress shall hereafter direct."

At that time but little was known of our mineral resources. The western precious-metal regions were largely within the domain of Spain; Alaska was Russian territory. The copper regions of the Lake Superior district had just come into possession of the United States by the treaty of peace with Great Britain. Some gold had been found in the Southern States, but the economic minerals were but little known or used.

The act of 1785 was but partially carried out, and on March 3, 1807, Congress enacted that the lead mines in the Indiana Territory, comprising Indiana and Illinois, should be "reserved for the future disposal of the United States," and authorized the President to lease any lead mine which had been or might thereafter be discovered for not more than five years.

The policy of leasing mineral lands was established by the passage of this act. The leases granted embraced tracts at first 3 miles square and later 1 mile square, and required the working of the mines with due diligence and the return to the Government of 6 per cent of the ore mined.

Seven separate acts were passed by Congress between 1800 and 1816 relating to salt springs and lead mines.

The policy of the Federal leasing of mineral lands was in effect a little more than 40 years. The operation of this system did not bring about any substantial development of mineral resources, did not bring to the Government any substantial income, and did create much discord.

President Polk, in his first annual message, December 2, 1845, said:

> The present system of managing the mineral lands of the United States is believed to be radically defective. More than a million acres of the public lands, supposed to contain lead and other minerals, has been reserved from sale and numerous leases upon them have been granted to individuals upon a stipulated rent. The system of granting leases has proved to be not only unprofitable to the Government but unsatisfactory to the citizens who have gone upon the lands, and must, if continued, lay the foundation of much future difficulty between the Government and the lessees. According to the official record, the amount of rents received by the Government for the years 1841, 1842, 1843, and 1844 was $6,354.74, while the expense of the system during the same period, including salaries of the superintendents, agents, clerks, and incidental expenses, were $26,111.11, the income being less than one-fourth of the expense. To this pecuniary loss may be added the injury sustained by the public in consequence of the destruction of timber and the careless and wasteful manner of working the mines.
>
> The system has given rise to much litigation between the United States and individual citizens, producing irritation and excitement in the mineral regions and involving the Government in heavy additional expenditures. It is believed that similar losses and embarrassments will continue to occur while the present system of leasing these lands remains unchanged. These lands are now under the superintendence and care of the War Department, with the ordinary duties of which they have no proper or natural connection. I recommend the repeal

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of the present system and that these lands be placed under the superintendence and management of the General Land Office, as other public lands, and be brought into market and sold upon such terms as Congress in their wisdom may prescribe, reserving to the Government an equitable percentage of the gross amount of mineral product, and that the preemption principle be extended to resident miners and settlers upon them at the minimum price which may be established by Congress.

In accordance with these recommendations, the acts of July, 1846, and March, 1847, made a radical change in the disposition of mineral lands on the public domain, abolishing leases and substituting cash sales therefor. By the act of 1849 the charge of mineral lands was transferred from the War Department to the Department of the Interior.

The more liberal policy of dealing with public lands soon manifested its advantage. As early as the year 1854 the Commissioner of the General Land Office gave expression to the following language:

It is impossible to portray the benefits already derived by the West from this system. Immense regions have been disposed of that were thought to be wholly unsalable because of the difficulty of access. The Government has consequently been benefited.

Reference was made to the fact that the Government had already received $146,195,641 for the sale of land in the South Atlantic territory.

The benefits of which go chiefly, if not entirely, to the people of the old States. This amount, it will be remembered, is exclusive of the sum of more than forty-eight and one-quarter million dollars net receipts for imports at the ports of Florida and Louisiana, which went into the Treasury and by which the people of the old States were also proportionately benefited.

Thus it will be perceived that mutual benefits to an immense extent and in about equal proportion have flowed to both the old and new States under this judicious system, and if either has apparently the advantage it is all in one great family and not a sufficient ground of controversy between fathers and sons. The true policy of the land system is, first, to encourage the actual settlement and improvement of the public domain.

The discovery of gold in California early in 1848 marked the beginning of a new era in the history of our country. The treaty with Mexico, by which this territory became the property of the United States Government, was concluded 15 days after the discovery of gold. Had this discovery been made a few months earlier, it is hardly probable that the treaty would ever have been made upon the terms which were concluded, or perhaps not at all.

Only six years before, in 1842, what was later known at Sutters Creek, where the first gold discovery was made, then known as Fort Ross, was sold to Gen. Sutter by the Russian Government. Had this discovery been made a few years sooner, during the Russian occupation, the map of the world would have been different. The timing of this discovery was perhaps the most fortunate circumstance in our history.

This area, ceded by Mexico, was placed under a military governor, whose control was autocratic, because of the fact that the laws of the United States were never extended to cover the territory. No effort was made by the military governor to prescribe rules or laws for the government of this section, and the gold hunters who came made their own laws and prescribed rules for the location and working of mining claims. Miners' districts were organized, each establishing its own regulations.

Up to that time Mexican laws and customs had prevailed in California, under which the rights of a claimant were bounded by lines extending from his exterior boundaries vertically downward. The military governor at once proclaimed that "from and after this date the laws and customs now prevailing

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in California, relative to the denouncement of mines are hereby abolished." The California miners immediately established the rule that the discoverer of the apex of a lode should have the right to follow it to an indefinite depth without regard to the ownership of the surface above. The vein itself was the principal thing and the surface in which it outcrops a mere incident. This principle was embodied in the first Federal legislation, and furnished the basis for what is now called the "apex law."

The custom thus established, of permitting the miners in the several districts to establish their own rules, was recognized by State legislatures in numerous acts, and the basic principles so adopted were to a large extent embodied in the first Federal statute enacted by Congress in 1866.

It is not without interest to note that a bill providing for the working of gold mines in California had been introduced by Senator John C. Fremont, in September, 1850, and that during all of the years succeeding, until the act of 1866, efforts had been made in Congress to enact laws controlling this subject. In the meantime the production of gold and silver in this western territory had amounted to $900,000,000, mostly from the States of California, Nevada, Colorado, Montana, and Utah. All of this production had been taken from the land of the Federal Government without legal right. From a legal standpoint every miner was a trespasser upon the public domain, and it was not until the act of 1866 that any authority was given by which the discoverers of mineral wealth were given the right to operate and the opportunity to become the owners of such property. During this period the Civil War had been fought, the credit of the Nation had been saved through the enormous production of gold and silver, and conditions created in the West for a great industrial development.

By the act of 1866 Congress declared the occupancy and exploration of the public mineral lands free to all citizens and confirmed the rights which had been acquired in these lands under local regulations. These regulations provided only for ownership in the lode, with its dips, spurs, and angles, and not to any portion of the adjacent surface. Priority of discovery and location formed the only basis of the possessory title which was validated by the act of 1866.

The act of May 10, 1872, enlarged the scope of the act of 1866 and made provision for patents to so much of the surface as seemed necessary to the proper operation of the lode. The act of 1870 made provision for the location and patent of placer claims. Under the operation of this system more than $5,000,000,000 in gold and countless billions in other minerals have been produced; the trans-Missouri country has been transformed from a practical waste to an empire. The amount received by the National Government in internal-revenue taxes is many thousand times in excess of the amount paid for the territory.

In the year 1850, two years after the discovery of gold, the total population of the precious-metal mining States was 178,818; in 1910 the same territory had a population of 6,825,821. In 1850 the assessed valuation was so small that no record is available; in 1910 the assessed valuation was more than $5,000,000,000. The internal-revenue taxes paid each year to the National Government by those States amounts to more than $15,000,000, the cost of collection being about 1½ per cent.

It may be said that the country would have developed without its mines, but the 200 years previous to the discovery of gold brought only a few trappers and hunters, and it is safe to say that the great development of the West was made possible by gold production. Great commercial development of the East followed quickly after, and it is safe to say that the $5,000,000,000 of gold

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which poured from the mines of the West into the arteries of trade and commerce was a dominant factor in making the United States the financial center of the world.

Abraham Lincoln laid down the principle which has controlled the public-land policy in his memorable statement: "The public lands are an impermanent national possession held in trust for the maturing States."

The liberal policy founded on that principle continued for a period of 40 years without serious question as to its advisability. Occasionally a lone critic voiced the sentiment that all the people should profit by the enhanced value of property brought about by increasing population, and reference was made to the fact that Manhattan Island, purchased in the year 1631 for $24, had grown to an assessed valuation of more than $4,000,000,000. The belief was expressed that this immense increase in value should have benefited the whole people rather than those whose occupancy had made it valuable.

After 40 years had passed this idea, based upon accusations of fraud and dishonesty, commanded so much attention that in the year 1906 an order was issued by the President withdrawing thousands of acres of mineral lands from entry and settlement. This order served to prevent the acceptance of filings upon the mineral lands withdrawn and to make more difficult the securing of patents by those who had applied for them.

It was alleged that monopoly had its root in the private ownership of natural resources. The frauds which had been permitted by the lax administration of the existing law were counted as evidence that the law itself was bad.

A propaganda was carried on looking to the repeal of the laws controlling coal, oil, and phosphate lands and water powers and the substitution of a system of leasing by which control should be continued in the Federal Government. It is claimed for this system that its operation will prevent monopoly and that it will give to all of the people the benefit incident to ownership in these valuable assets, and that effective conservation is only possible through centralized control.

On the other hand, it is urged by the Western States that the application of this system will throttle development; that it will perpetuate a monopoly in those who have already acquired ownership in mineral resources; that it will create a system of landlord and tenant between the Government and its citizens, entirely subversive of the best interests of the Nation; that the States will be unable to maintain law and order over the whole of a territory more than one-half of which is exempt from the State taxing power, without unjust burdens upon its taxpayers; and that in order to properly maintain its hospitals and asylums, its courts, its schools, and public roads, the State must have the right to tax all the property benefited by these public agencies.

The official call for the eighteenth annual convention of the American Mining Congress submits this question for discussion, in the following language:

> Whether the Federal Government shall lease the coal, oil, and phosphate lands and water powers or whether these shall pass into private ownership and subject to the State taxing power, is a question of vital importance to the West.
>
> As an illustration: The coal reserves of the State of Wyoming are estimated at 424,085,000,000 tons. Let us suppose that 25 per cent of this estimate is available for production. A royalty of 2 cents per ton to the Federal Government would amount to $2,000,000,000. If 10 per cent of the estimated coal were to be placed on the market during the next hundred years it would mean, at 2 cents per ton royalty, $800,000,000, or $8,000,000 annually, to be derived by the Federal Government from Wyoming, while Pennsylvania and the other great coal-producing States of the East would go entirely free from paying similar tribute.

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Ten per cent of the estimated coal reserves of the States of Wyoming, Montana, Colorado, and Utah, at 2 cents per ton royalty, would net the Federal Government $2,500,000,000, one-third more than the aggregate bonded indebtedness of all of the States and cities of the United States.

The water powers of the West are more valuable than its coal reserves, and a most modest royalty will net a fabulous income, all of which will be a special tax upon the Western States for the support of the National Government not imposed on the Eastern States.

The question is one which has direct bearing upon mining development and operation, and should receive the serious consideration of the convention.

In reply it is urged by the advocates of this system that it is proposed to place the royalties received in the reclamation fund, to be used in the development of western irrigation projects, and that when the Reclamation Service has returned this money to the Federal Treasury one-half of the fund shall be paid over to the State from which the amount was derived.

To this it is argued that the State is entitled to and needs all of the tax during the days of development, and that the system will prevent the creation of industries which would bring vast assistance in carrying the State burdens. It is further urged that if "all of the people" are to be benefited by the earning power of the Government property that her rivers and harbors and her ocean front should also be made to pay tribute. "Why," it is asked, "should the people of Boston have the sole benefit of her magnificent harbor and the cheap transportation which it affords while the people of Colorado are forced to pay tribute for the use of her water, which makes for cheaper power for her transpotation and industries? Why should the citizens of New York have the free use of the Hudson River while the people of Utah, who are joint owners, are denied that advantage," and yet forced to pay royalties upon the natural resources within her borders?

Why should Boston, New York, and Baltimore have the benefit of the cheap ocean transportation facilities for the foreign and coastwise commerce, which has so largely contributed to their commercial growth, while Wyoming is required to pay a royalty for the coal and oil which nature stored in her bosom ages before she gave water facilities to the coast States?

The fight for and against the leasing system has been waged for many years with much bitterness. This has been intensified by the claim that the presidential withdrawal orders failed to make proper provision for those who claimed inchoate rights under the law existing when the withdrawal orders were made.

The experience of Alaska is pointed to as the most radical illustration. The discovery of large deposits of placer gold in the Yukon Valley in 1885 led to a rush of gold seekers. Other discoveries followed, resulting in an output of Alaskan gold in 1900 of over $7,000,000 and in 1906 over $21,000,000.

The increased need for power called renewed attention to Alaska's coal deposits, and efforts were soon made for their development. It was found that no United States law provided for the location of coal claims in Alaska. On June 6, 1900. Congress extended the general coal-land act of 1873 to Alaska. This law applied only to surveyed lands, and as Alaska has not been surveyed the law was entirely inoperative. It took Congress four years more to provide for coal locations by private surveys, but the act of 1904 limited locations to 160 acres. About 1,000 claims were located under this act. These claims were surveyed at great expense by the applicants, who paid into the Federal Treasury more than $850,000, as required by the law, preliminary to making final proof for patent. It was then discovered that the law did not permit the grouping of claims. It was evident that 160 acres was not sufficient to justify equipment extensive enough for economical operation, and in 1908, four years



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later, Congress passed an act carrying severe restrictions and penalties against monopoly but permitting the ownership of 2,560 acres in one holding.

Under the provisions of this act attempt was made to so unite claims as to make feasible the successful operation of coal mines. For more than 12 years efforts had been constant to make the coal of Alaska available for use in mining and the various industries which follow, and the way now for a short time seemed open. The act of 1908, intended as a remedial measure, was held to apply only to locations made before its enactment, and also that if the locators at the time of location intended to consolidate with other claims in order to do that which the bill permitted, that such intention constituted a fraud which the act did not cure. The very necessity for the enactment of the law was made to justify a belief that the locator must have intended to combine his claim with others, as without such combination it was worthless. This led to wholesale charges of fraud against all coal locations, making even this act inoperative.

The presidential order of 1906 withdrew from entry all coal lands. Some months later the order was so modified as to except valid prior locations and permit action upon existing entries. The applicants for patent—who had endeavored to live up to the requirements of the laws by which Congress had attempted to make possible the development of Alaskan coal lands; who had spent millions of dollars in surveying, road building, and other improvements; who had paid their money, more than $350,000, into the Government Treasury, instead of receiving patents to the land applied for—found themselves under the surveillance of various special agents sent out to examine the validity of these locations. Every failure to meet the strict technical requirements of the law was sought out. Many of the applicants were indicted, tried, and acquitted; but, with the exception of two inconsequential claims, no patents have been granted.

These pioneers in all prior ages would have been crowned as public benefactors; now they are broken in health and spirit, financially ruined, and rest under the stigma of criminal indictment and prosecution. A sorry reward, indeed, for pioneers who endured the hardships and privations of frontier life, who risked their lives and lost their fortunes in the effort to develop this last frontier of American civilization.

But the worst has not been told. A few of these pioneers had not entirely surrendered, a few indomitable spirits still insisted upon the constitutional right of even the meanest of American citizens—the right to have his claim passed upon by the courts of his land—and did not propose to surrender his rights until a judicial tribunal should so order.

The United States Government is immune from prosecution. A law providing for Federal leasing of these same lands was being considered by Congress. While the Government could not be sued, a lessee of the Government might be required in ejectment proceedings to prove his better right in order to maintain his possession.

A committee of the House of Representatives of the United States, in order to take from the Alaskan coal claimant his last opportunity to protect his rights and defend his name and reputation, put this cunning section into the bill H. R. 14233, Sixty-third Congress, approved October 15, 1914:

SEC. 13. That the possession of any lessee of the land or coal deposits leased under this act for all purposes involving adverse claims to the leased property shall be deemed the possession of the United States, and for such purposes the lessee shall occupy the same relation to the property leased as if operated directly by the United States.

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This bill was enacted by Congress and for 15 months has been the law. No leases have yet been made; and the coal of Alaska, after 30 years of effort, is as effectually locked up to-day as at the beginning.

This Alaskan experience furnishes reasons why many citizens believe that the Government should dispose of all her public lands in limited areas to individual citizens at the earliest time possible, having due regard for other citizens who might desire to receive of the national bounty, excepting only such property as is needed for governmental purposes.

These argue that the direct management and supervision of mines and the agencies necessary to make governmental control effective will largely augment the functions of our Government and force it into comparative business competition with her own citizens.

Many others equally sincere, believe that the Government should retain ownership and control of these minerals which, being once exhausted, can never be reproduced, and which are essential to our industrial progress. Just what the future control of the minerals on the public domain is to be will probably be decided by the present session of Congress.

These are the arguments and these the principles involved in a controversy which both sides agree is one of the most important internal questions ever presented for consideration to the people of the United States.

Mr. BALL. I would like to say a few words about some of the statements in Mr. Callbreath's paper. He states that a people who own their own homes are the most democratic people and that any system which grants the people their homes is a desirable system. By inference, he applies that to mineral lands, the suggested idea being that in order to grant homes to the home-making people you should grant the title to mineral lands.

There has been a good deal of vague thinking on this question because of the confusion of the home-making title and the mineral title. The arguments have gone back to the tenancy days of Ireland and of Scotland, where a man did not own his own home, but held it under lease from some absentee landlord. I need not outline for you the conditions that resulted from that absentee ownership of the homes of the people. But that has nothing to do with the ownership of mineral lands, on which no man makes his permanent home. I am reminded of arguments in Congress prior to the passage of the placer act of 1870. I don't know whether you have read the Congressional Globe of that period or not, but if you will read it you will find that the reason for the passage of that act was not for the purpose of giving miners title to the placer ground which they were using for mining purposes, but, as Senator Stewart, of Nevada, has said, this bill was proposed for the purpose of attaching the wandering nomadic population of the mining districts to the soil, so that they might become a permanent home-keeping population on their placer claim.

If ever there was confusion of ideas it was right there. Anyone could tell you the results. The placer miners have not yet been made a permanent home-making population. They still remain

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nomadic. So it seems to me that any argument as to the necessity of a man owning his home has nothing to do with the necessity of granting absolute title to mineral lands.

There are certain other things in Mr. Callbreath's paper which I wish I remembered clearly enough to discuss, but one thing that struck me most forcibly was his reference to Alaskan conditions. That Alaskan conditions have been unfortunate, the most ardent advocate of Government leasing will admit, but there are other factors that must be taken into account when the statement is made that although the leasing law has been in operation for over a year no leases have yet been taken out. Lack of transportation is one of the important things we must consider. Another factor is California oil, which supplies the Pacific coast and will for some years. When coal, a good deal of it as good as Alaskan coal, in beds as much as 6 feet in thickness, lies practically untouched at San Francisco's back door, there is not much argument for going into Alaska, a long way from transportation, and trying at the present time to open up the Alaskan coal fields.

Mr. LESHER. Mr. Callbreath spoke of the situation in Wyoming, and stated that if 10 or 25 per cent of the coal was sold, the tax of so many cents a ton would be so many million dollars, and compared that condition with Pennsylvania. Pennsylvania is now collecting by a State law 2½ per cent on the anthracite coal production. The operators, of course, are attempting to prove that this law is unconstitutional. But the tendency is to tax gross outputs, and whether it is done through the medium of the State government or the Federal Government is perhaps not so material as the question of what becomes of the money after it is collected. Under the proposed system of leasing, or any of the proposed systems of leasing, the money collected from royalties will go back to the territory from which it is taken, as you know, partly as a direct return to the State or partly as an aid to reclamation of land.

I did not infer from Mr. Callbreath's paper that he objected to the sale of public coal lands at an appraised value. I infer that he approved of selling the land at prices in proportion to its value. One of the principal arguments in favor of leasing as against sale at appraised values is that leasing for a royalty is more favorable to the lessor because it is not always possible to ascertain exactly the quantity of coal under a piece of land until it has been developed. If the land is leased the operator then pays on the output from day to day or month to month. If he buys it outright under the present system he pays a lump sum at the beginning based on the assumed royalties that would be derived if the land were leased, and royalties paid as production progressed.

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The writer emphasized the idea that the industrial development of the West has been hindered by the withdrawal of coal lands and that it will be retarded by the leasing of the coal lands. I might point out that it is only too well known to those familiar with the coal situation in the United States that the productive coal capacity of our coal mines is considerably in excess of our demands. That condition is considered lamentable, and has caused in slack times a demoralization in the coal trade. That is particularly true, of course, in the East, where greater development has taken place; but I have seen it stated by some of the State mining inspectors, by one particularly in Colorado several years ago, when the greatest agitation was on against the withdrawal by the President of coal lands, that the productive capacity of the coal mines in Colorado was in excess of the demand, and that if the Colorado producers expected to make money they would have to seek markets in the Middle Western States.

Practically all of the coal operators in Colorado, Wyoming, and other Western States producing steam coal and coal for industrial purposes have considerable acreages. A good deal of the land, as the Land Office records show, was originally taken up as farming land, innocently enough, perhaps, under the preemption and homestead laws, and has since been acquired by the coal mining companies. Other large parcels were acquired as coal lands at a minimum price of $10 and $20 an acre.

The point I want to make is that these companies have a large acreage of developed and undeveloped land, sufficient I think without question to supply the need for coal in those States.

Mr. WELLS. I am a little in doubt where to begin with my dissent from Mr. Callbreath's paper. In the first place, with respect to the old mineral lease system as contrasted with the liberal system of free distribution of the public lands that followed the preemption act of 1841 and was applied shortly thereafter to mineral lands, he told us, quoting from President Polk's message, that the income for a certain period of time was something like $6,000 in royalties and the expenses were something like $26,000, and that it seemed a very inefficient system; but when we come to consider the free distribution system he tells us that the public lands of the United States cost $76,000,000. Is that your figure, Mr. Callbreath, for what was paid to the foreign nations that ceded them to us?

Mr. CALLBREATH. All the payments that were made under cessions and purchases.

Mr. WELLS. Then I call attention to the fact, in the first place, that having bought them from the foreign nations we bought a good many of them over again from the Indians. I would therefore add that

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to his capital cost. He takes no account whatsoever of the administration expense of the free distribution system. The administrative expenses of the leasing system is the only thing that makes the other system look bad from a financial standpoint.

How much has it cost to administer the free distribution system? How many millions of dollars or hundreds of millions of dollars in all these years? However, I merely point that out as an example of what seems to me an inadequate consideration of the proper measure to be applied to these things. None of us would judge this upon a profit and loss basis. The proposed leasing system is not proposed primarily as a means of public revenue, but as a means of social justice and of development, as opposed to monopolization of resources.

Mr. Ball has spoken of the home-owning arguments used by Mr. Callbreath. I want to add a word or two about that. The home-owning argument holds up for our admiration what they call in Europe the peasant proprietor, the small man, the economically small man, owning his own home, and he had the small farmer in mind, probably, working his farm with his own labor, or possibly having a hired man or two; and I heartily agree that there is no better foundation for social order than that. But we are asked to jump from that to the distribution of mineral lands and their passing into absolute private ownership. Now, I do not know intimately much about the situation in Colorado or in Michigan, but I would ask every man in this room, after he has gotten over his admiration of the peasant proprietor as I have described him, to think about the man on the coal lands of Colorado and the copper lands of Michigan in the last three or four years. How far do they resemble the peasant proprietor? We all know that they are more or less at the mercy of the persons to whom the legal absolute title to those lands has come. I do not know how that power has been exercised, or how it will be exercised, but we all know that the men on the ground who are doing the work are thoroughly discontented.

One thing more. Mr. Callbreath's paper pointed out to us the enormous revenue that might come to the United States from the Wyoming coal lands, and the Government was represented—that is, the United States was represented—as a sort of bloodsucker, sapping the life of the Wyoming of the future and in contrast not getting anything out of Pennsylvania.

Now, I have not a word to say for Pennsylvania. A good many men in this room, however, remember when the ruling rate for anthracite coal was $4.50 put in the cellar. We are paying $7.50 a ton for it now. Is Pennsylvania getting that $3? The owners of

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those lands are getting the $3, and if Mr. Callbreath's ideas were carried out with respect to Wyoming, Wyoming would not keep the $8,000,000 a year that he is talking about. Wyoming would still pay $8,000,000 a year to somebody. The fundamental question of the leasing system is whether they shall pay it to the public or whether they shall pay it to private monopolies. That is the essence of this thing, and it is entirely misleading to assume that that $8,000,000 is going into the Wyoming treasury if the old system prevails.

Mr. WEGEMANN. It seems to me that one of the greatest arguments for the leasing system is the Government control of the lands which are leased, and the prevention of waste of the minerals contained in those lands.

Those of us who have been in the oil or coal fields have seen many of the wasteful methods which are employed. We have seen small operators, owning adjacent tracts, drilling wells when they knew they had no pipe-line facilities and would have to put it in storage in vessels where much of it would evaporate, or in steel tanks which would likely be struck by lightning; and we have seen hundreds of thousands of barrels of oil wasted merely because one man was trying to get the oil before his neighbor across the way could get it.

Granting that all of the arguments of Mr. Callbreath can be upheld, it seems to me that we will be saying to the people of Wyoming, supposing that they are paying this tax directly to the Government, that loss is many times made up by the preservation to the State of vast resources which will last for generations, if properly conserved to avoid waste.

Mr. STORRS. I regret that I did not hear Mr. Callbreath's paper and also must confess that I have not examined the latest form of lease that the Government bureaus have devised, but I did have some conferences on the original lease planned for coal lands, particularly with a view to Alaska. One of the greatest defects of the lease plan, as I then knew it, seemed to be its inelasticity to meet all the conditions. What might be devised for some Western States in a flat mining country with shallow shafts, would be absolutely unsuited for the Alaskan conditions, and the acreage allowed to be taken up by any one lessee where the topography and railroad outlet conditions would be such as they were in Alaska, seemed to be absolutely inadequate. It would mean that the fringe of the coal measures along the streams and readily accessible might be leased, but the great body of the lands would then be tied up, absolutely inaccessible to anyone; and that seemed to be the great defect of the lease as I saw it. It seems to me that it is advisable to lease the lands.

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A statement was made by Mr. Wells, as to where the $3 a ton has gone. I think it is hardly fair to say that the landowners have gotten that. A large part is in the railroad treasury. And it happens that the railroad in many cases owns a large part of the land. It also happens that in some cases some of the shrewder owners are getting some of that benefit. I have in mind a recent case where, the price being based on the average tidewater price, the owner is now getting 43 cents, whereas in the old times he used to get only 23 cents.

The CHAIRMAN. Is there further discussion of this paper?

Mr. CALLBREATH. Mr. Chairman, reference has been made to the lack of clearness in the reference to making homes upon mineral lands. What I object to is the change from the system which has made for industrial development and for happiness, peace, and prosperity. It is not expected that the owner of a mineral claim will necessarily make his home upon it.

Some one has said it is not so material whether the tax shall go to the Federal Government or somewhere else. Reference has been made to the tax on coal in Pennsylvania of 2½ per cent. That goes to the people of Pennsylvania, if it is declared constitutional, and they are entitled to it. If the lands of the West shall be taxed by anybody they should be taxed for the support of the development of those States. The basic principle of our Government is home rule and to the extent that we undertake to infringe upon the right of the people to govern themselves, we menace the Federal Government.

Some one—I think it was Mr. Lesher—said that this talk with reference to the hindering of development was mere prophecy. If you will pardon me for a moment, I will cite one instance which I think will appeal to you as being very real.

In the State of Colorado, four or five or six years ago, Mr. Bolthoff, of the Hendrie & Bolthoff Manufacturing & Supply Co., a large concern engaged in mining and manufacturing, went up into the valley and took up a mill site and several claims on the side of the hill. He spent $60,000 in a preliminary way, and developed a sufficient ore body to justify the construction of a mill. He bought his machinery, spent $25,000 in getting ready, and ordered $20,000 or $25,000 more of machinery to be put upon that mill site in the valley.

He saw that his mining claim would justify the expenditure, and he proceeded to have his attorneys apply for a patent. He was met by the statement that this land had been withdrawn as a water-power site and that he could not get a patent to that land. His lawyers came to Washington and went before the Land Department. After several days they managed to get a hearing before some officers of the Interior Department. I think that was a year ago last August.

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That case has not yet been decided, unless it has been decided within the last few days, and Mr. Bolthoff's investment of $125,000 is lying dormant, and in my judgment development has been hindered.

I can give you many more cases of a similar kind, but I think that one instance is sufficient to show that mining is hindered. It is not in opposition to the leasing system that I argue; I argue in opposition to a Federal leasing system. I believe in home rule—that each State should control its own matters—and unless we do that I think we will have trouble in the future.

The CHAIRMAN. The second paper this morning will be on the "Valuation of Federal coal lands," by Messrs. R. D. Hall and Floyd W. Parsons.

## VALUATION OF FEDERAL COAL LANDS.

By FLOYD W. PARSONS and R. DAWSON HALL,
*Editorial Staff Coal Age, New York City.*

Perhaps the first question to discuss is whether we are justified here in the East in canvassing a question of this sort, the answer to which is at best only indifferent to us. If the coal mines of the West were closed down entirely, it would do us little harm and might help to stimulate eastern trade.

No doubt the people of the East do not look upon the matter from such an ignoble point of view, and doubtless the eastern conservationists are ever animated by the noblest of purposes. But the fact remains that their interest, if they have one, is like the interest the British had in our infant iron trade before the Revolutionary War—an interest in its suppression and not in its development. But, again, for fear we may be misapprehended, we repeat we do not believe that any such narrow view animates our conservationists, who, without exception, are doubtless well meaning. But if the advantage of suppressing the western coal trade has never appealed to them, neither has the death and stagnation of that trade ever stirred them to action.

We must remember that the size of the United States permits us to overlook local conditions of financial and physical death. Absentee landlordism by the Federal Government is not entirely cured by our representative provisions. The majority may so override the minority that the latter might as well be deprived of a vote. Moreover, the virtues of the landlord do not save him from false judgments. Near-hand investigation will alone do this. The essential of presentee landlordism is the immediate sensing of the economic conditions arising from the management or mismanagement of an estate. This essential is absent in our national economy. If Colorado, Utah, or Wyoming does not prosper, no feeling of discomfiture steals over the Department of Public Lands or the Geological Survey at Washington.

In this connection it might be well to quote Secretary of the Interior Franklin K. Lane's report to the President in 1914 relative to Alaska. He said:

> There can be no satisfactory administration of land laws nor any other laws at a distance of 5,000 miles from the point of action. * * * The eye that sees the need should be near the voice that gives the order.

There is too much talk of Federal lands and national domain. We shall only alienate the West until we learn that the lands of the West belong to

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the people of the West; that they have a right to regulate their disposal; and that we have scarcely any more right to determine the price and distribution of western lands than the British Government would have to dispose of the vast acreage in Canada or Australia.

What right have we? We acknowledge that it is not a property right, for very correctly we have arranged that the West shall receive all the money received from the sale of lands for western development. Our attitude, then, is that the West is not fitted for the control of its own resources, which is precisely the attitude which has been repeatedly dubbed toryism. If a State can not solve its own land question then it is most surely in swaddling clothes.

Let us enunciate the conservationist's argument: "We have so much more experience and have such complete financial aloofness that we can be relied on to do what is best." But in such a statement we overlook the fact that newer communities can not grow when they have the bands of older communities to restrain them, and that the people who are not personally interested in any problem approach it always in a way more academic than practical.

We are apt to write our laws as a boy pens his college thesis, freed from the trammels of experience. What does it matter if he is wrong? None of his money is involved; his job is not threatened. What does it concern us if we are in error? We, the conservationists of the East, will not suffer and may even profit; our business is not threatened. But the West knows it is its own problem, and if it is left to the people of the West and they settle it wrongly, on their own heads will be the disaster.

The outcome of mismanagement comes home to them with all its discouragement. We can spin filmy visions of our imagination and believe we are handling matters altogether for the best. For instance, we can imagine that we can evaluate a property by comparing it with another property in another place and then convince ourselves that it ought to sell at that price. If we are really interested when we find it does not we conclude we were wrong; if we are not interested, why we don't come to any conclusion whatever.

It is a mistake to take a piece of property on Union Hill, N. J., and compare it with another on Riverside Drive, New York City. The Union Hill ground lies so much higher and looks therefore so much more desirable that it really ought to be held at a better price than land on the Drive. But it is not. The psychology of real estate prevents it. Really, the only difference between the properties we can find is that one is near a center of population and the other not, and after all that is the difference between Pennsylvania and Utah property. Nevertheless the Geological Survey still holds that if an acre of Greensburg, Pa., coal were carried like the magic carpet to some point in the West it should retain, perhaps not the whole but a large percentage of its value.

A rich man owned a large square tract of good land with railroads on two sides of it. A contractor owned another square, not quite so good, in another crotch of the intersecting railroads. The first held his lands at $600 a lot and practically sold none. The second sold his lots at a more reasonable figure, but competition so briskened business that the contractor's lots were many of them sold at twice or three times as much as the wealthy man asked for his in the first instance.

You can only get your price for coal or any other land by creating a body of competing land holders. There certainly is such a thing as unearned increment, but remember it is an increment, a growth, a development, not a creation. It grows by its own laws, not on the fiat of the rich man or the Government. It increases from year to year when the acreage available is limited.

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It has for many generations been our boast that the land of this country was not held by a few large landowners, who did nothing with it and paid minimum taxes. The argument seemed good to most of us, but we have in the United States Government a land holder larger than any other, who pays no taxes whatsoever and sells its coal land only at the most exorbitant figure. Its intentions are doubtless benevolent, but benevolent people have a way of being exasperating, especially when they are not made to feel in any immediate way the consequences of their acts.

These remarks apply to all coal land now belonging to the public domain. It is all held at too high a price. Of course, it will be said that to make that statement requires expert knowledge of all western lands, and that only a few men, like George Otis Smith, the director of the Geological Survey, and G. A. Ashley, of the Coal Land Classification Board, have such a comprehensive knowledge.

It may be well to grant them a most liberal and broadly a most exclusive knowledge of the value of Western coal lands, but the price to a practical man is set too high if the objects offered will not sell as appraised. Of course, for a year or two buyers might hold off, but the classification and evaluation has continued for many years and purchases are quite insignificant compared with the coal land held by the Nation.

It is not necessary to show that the elaborate equation of the Geological Survey is wrong. All that we need to know is that the result it obtains does not work out in practice, however clever may be the algebraic formula of its geologists.

Unfortunately it is sure that in many cases the Geological Survey arrives at incorrect evaluations of coal quality, with most unfortunate results. It is stated that one large sale was made on the basis of a geological evaluation of the coal since found to be faulty. That is not wonderful. No technical blame adheres to the survey for this misjudgment of value. It is the commonest of experiences when the buyer relies on the geologist and not on the drill. There are no geological bulletins better than the Geological Survey produces. The British publications fail to be equally instructive and complete. But mere comparative excellence is not enough. If a price is put on coal land by the Government, it is supposed to be based on a correct knowledge of the coal value; and if it is not, the gullible public may purchase a gold brick from the United States with U. S. stamped on the brick both on face and obverse.

It might be well to refer again to the same report of the Secretary of the Interior to which we have already referred. In fact, it seems apparent that he guides the pen in all that has been here written on the subject, so just appear to be so many of his conclusions. He says:

> Our coal land is not being used under this plan, save under exceptional conditions of local and immediate demand, and the purchaser, when there is one, is speculating on the best guess that an honest geologist can make as to the amount of coal in the ground.

Is it necessary to quote the number of entries to convince you of the truth of Secretary Lane's conclusions as to the volume of sales? In 1907–8 there were 299 entries, and in 1912–13, 71. The valuations in the first fiscal year mentioned were $636,663.18, and in the second year $307,487.95, though the average price per acre for the sales rose 22 per cent per annum.

Whether the sales in 1907–08 were all of classified land there is no way of ascertaining from the reports made. There is some reason to suppose that a large part of the lands sold in that year were filed on before withdrawal and

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valuation. This makes it a fair conclusion to believe that at no time have really classified coal lands been in demand.

But another fact should not be overlooked. The valuations at first made were based on a much lower schedule than that now obtaining, so that the possibility of making sales at present prices is in no way evidenced by the sales at earlier valuations or under no valuation at all other than that provided by the minima in the Revised Statute 2347.

The sales of coal land already made were in some cases sales which would have been consummated if not a ton of coal had appeared on the property. The only part coal had in their transfer was to make the land valuable by its being found in large quantity near by. These properties were bought that lots might be sold to saloon keepers who could not locate on the property of the coal companies.

The Government has sold these properties to people whose sole aim was to corrupt the morals of the miners by liquor, fan-tan, and in other undesirable ways. Of course, it was not the intention of the Government, and the high price charged for the lands was the one redeeming feature of the transaction; but anyone who has seen these squalid sixteenths of a square mile would wish the United States had not used its public domain to debauch the peoples rather than to enrich them.

The question whether the West has suffered as a result of the restrictive action of the withdrawal and classification is not a matter which can be submitted to proof. It has, however, been asserted by a commissioner of the Land Office in his report of June 30, 1910:

> The progress of advancement in the West is being retarded under present conditions by the difficulty in the successful operation of new mines under legislation as it exists to-day. Competition has been checked. The consumer is having to pay, therefore, a greater price than it would be reasonable to expect he would have to pay if it were possible to open mines under legislation which would encourage the development of mines.

Another weak feature in the situation is that the present restrictions are hardly conservational. The outcrop is in large part sold, and the properties run into the hill till great depths are reached; in some cases the cover is 1,500 feet, for the measures frequently dip steeply. When the coal is worked out no more can be obtained. The landowner removes his pillars as far as he can and lets the roof fall in. What then is the condition of the Government land behind? It is only approachable by shafts as deep or deeper than the deepest shafts now worked in America. Unless accurate records have been made of the coal at the edge of the abandoned property nobody can hazard a guess as to the value of the acreage beyond.

The Government, if it has secured no record, knows nothing as to the level and character of the coal. This land should be drilled carefully and at much expense before it is mined to make up for the lack of records of the face once exposed and to provide further data. Even then the risk is considerable, for drilling is an uncertain way of proving coal. The uncertainty after drilling is not extremely harassing if the coal is shallow, for the drillings can be more frequent, and the financial hazard is not great.

But let the depth be 1,500 or 2,000 feet and the necessity for certainty becomes provokingly insistent. It is doubtful if the coal buried so deeply will be taken out for generations. Perhaps that is in itself no loss, but the regret is that when it is mined it will be done at unreasonable cost because the normal approach to it is closed. Had it been attacked from crop workings, whether it proved a poor or a rich deposit no great loss would have been incurred for no large investment would have been needed to reach it. The

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uncovering of a face would already have been accomplished and a few headings yielding coal would have been all that would be necessary to make proof of the value of the land, and if it proved stony the coal could have been rejected without loss to the operator.

One trouble with the present law is that it does not give acreage enough to one or a group of persons. No one can build a railroad and open up a mine readily if he is only allowed to work 160 acres, or even 320 acres, unless the coal be exceptionally valuable. But let us quote Secretary Lane again in the same report as has furnished us pabulum for so much thought already:

> Sufficient land should be leased as a body to justify long continued and economical operation. As the average of all operations in the United States is 2,600 acres, including many small holdings, this might be taken as the maximum unit.

The figure is somewhat low for thin coal, however, for a 5,000-ton mine would exhaust 2,600 acres of 3-foot coal in 10 years, even with exemplary conservation and with only reasonably steady work.

The principal fact, however, we desire to emphasize is not the defects in the law which we may not be able to understand and appreciate, but the fact that you and we appear to have undertaken to decide these matters for the West. We seem to have made up our minds that we should determine for them what is best and most desirable. Like old folks, too, we have decided that the young folks should not imitate our early careers. If we sold coal land in unlimited quantities in Pennsylvania for less than a dollar an acre, and in the Middle West for barely twice as much, we must not permit the West to do so, but charge from $10 to $600 per acre and restrict the area within the narrowest limits, despite the fact that modern commerce calls for larger operations. Let it be granted that we do not know as well as the guardians of the lands every detail of their value and every aspect of the western coal trade. Well and good; but then let us cease to legislate in defense of those guardians of the lands and concede to the people who realize the problems and have a right to the lands the privilege of controlling them. Excessive centralization is the bane of empires and may prove as harmful to our interests as was the confiding of the affairs of the smaller Byzantine empire to the Constantinopolitan logothetes.

The CHAIRMAN. Mr. Hall's paper is now open for discussion.

Mr. ASHLEY. Mr. Chairman, I think perhaps I am only fair in saying that partly as a result of Mr. Hall's editorials, the survey has scrutinized its own work very carefully, and may have revised it in some places. I think if you will compare the old regulations for fixing values with the revised regulations, under which we are now working, you will find that, as a rule, the newer rates are lower than the earlier ones. So, when we revalue land, the new values are, as a rule, lower. Allow me, however, to refer to two or three things in Mr. Hall's paper. First, in regard to what we may know of coal land without drilling. We must admit, perhaps, that when we attempt to say how much coal there is under a piece of land we are guessing. No one who has studied the coal fields extensively will admit any other conclusion. We can all of us point to particular areas where a coal field has been examined by a mining company by prospecting very carefully on the outcrop, and it has been thor-

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oughly disappointing when exploited. But there are just as many areas where drilling has proved to be just as disappointing. A piece of work now on my table contains two areas where drilling was thoroughly disappointing, as it showed apparent conditions which actual mining proved did not exist. So that while we must admit that judging of coal land by prospecting the outcrops of the coal beds is always risky, we should also recognize that drilling may be no less unreliable.

Had I known just what was coming up this morning I would have brought over a chart showing two groups of coal sections—one of a coal bed in Pennsylvania that we call the Upper Freeport and another of the Upper Kittanning. Judging only by the charts, the two coals run about the same in thickness. In computing the tonnage of the coal over 2 feet thick, between 1 and 2 feet thick, and that under 1 foot in a certain district, I have assumed that probably three-fourths of the Upper Freeport coal was 2 feet or more in thickness, and, on the other hand, that probably not over one-tenth of the Upper Kittanning was above 2 feet, notwithstanding that all the measurements on the latter coal made in the district were above 2 feet. The difference in treatment was because of known differences in the two beds. I have traced the Upper Freeport coal for 7 miles on the Allegheny River, where railroad cuts exposed the coal clearly for a third of that distance, and have traced it long distances through mines in many other areas, and I know it is a persistent bed. The Upper Kittanning, on the other hand, we know as a pockety bed with a great deal of low coal.

So, in getting facts for the valuation of the coal lands, we try first to determine the characteristics of each bed, whether regular or irregular, and so on; and if a certain bed appears from the data we have to be regular, it is given a higher value than another bed which appears to be irregular. If the data are insufficient to determine whether the bed is regular or irregular, irregularity is assumed. The survey attempts to make every allowance possible for the irregularity of beds or their being absent. The values of some of the coal lands of the West are high, as compared with values in the East, for the reason that, whereas most areas in the eastern coal field contain one or possibly two beds of a thickness of, say, 3 feet or thereabouts, and three or four other beds between a foot and 2 feet, possibly 3 to 8 feet of workable coal, many areas in the West have from 100 to 150 feet of coal in workable beds. You see at once where the difference lies.

If we were valuing coal in the East, such a series of beds as we find in Pennsylvania or Indiana, or in most other Eastern States, would receive no such values as are given the richer lands of the

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West. It is the large volume of coal in the West that gives these relatively high values.

Mr. Hall has compared western coal land values with prices of New Jersey farm lands. Theoretically we are not valuing the land. Practically until the law was passed allowing the separation of the estates, the land went with the coal, but the figure set was always on the coal when ready to be mined. Now, you may say, of course, that coal out in the State of Wyoming, a thousand miles from Chicago or any other large center of population, and away from everything, has no value. However, the profits on a ton of coal in Colorado or Wyoming are probably as great as in any State of the Union, and the value of a ton of coal anywhere is based on the profit when mined. I think my friends from Pennsylvania will substantiate me in that.

So that the survey believes that the prices put on the western coal lands are conservative and only a fraction of what the coal will be worth when mined. It is not worth that to be held a hundred years; there is no question about that, and it is not intended that it should be.

I think these cover the two special criticisms I had in mind.

The CHAIRMAN. Is there further discussion of Mr. Hall's paper?

Mr. LESHER. Two general propositions were advanced by Mr. Hall. He objects to the high prices and to the Federal Government handling the sales. Dr. Ashley has talked about the first. I will not take time to discuss the other, but I would like to ask Mr. Hall this question: If the States are to sell the land I should like to know whether he considers it should be sold at the price of a dollar, which he states prevails in Pennsylvania, or of $2, the price in the Middle West, or perhaps a little more in the far West. In other words, if the coal lands are to be sold by the States, are the prices too high for the States to put on them? Would he be willing that the State of Wyoming should charge those prices for its coal lands, or should it simply let them go, grab-bag fashion, at a minimum price?

Mr. HALL. In answer to that I would say that I do think we ought not to imitate the way in which Pennsylvania has disposed of her lands. I think we should not imitate the way in which the United States disposed of public lands in the earlier days. It is really a matter for the States. I believe that if they would use reasonable discretion the probabilities are that they would take a stand midway between the practice of the Federal Government and that of Pennsylvania in the earlier days, and do about the way Canada is doing to-day. I think they would adopt a policy under which they would sell the land. If they found that their prices were too high and that the lands would not sell, they would prob-

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ably lower prices. At the same time they would endeavor to prevent large land holders from acquiring the lands and monopolizing them.

I do not believe that in making some of these statements I represent the feeling of the large land holders or of the people of the West. I know one man has stated that he was of the opinion that the United States Geological Survey was handling things about right. He belonged to one of the large corporations out West.

Many feel the same way and are glad to see a restriction placed on the sale of coal land in the United States, because it helps to keep up the prices of coal in the West.

There are many people in the West who have large interests who are disposed to uphold the United States Geological Survey, and I am not representing that element at all. My idea is that the West has a right to control the West. Someone at the meeting of the Coal Mining Institute of America some time ago said, "You know the people out in the West think they own the West"; and I could not help saying to myself, "They don't miss it very much, or should not miss it very much." The people of the West should control the West. Who else should? Surely not we.

The CHAIRMAN. Before taking up the next paper I will announce that the same general topic will be continued to-morrow morning, when Mr. Mendenhall's paper will be presented.

The next paper on the program, which is of much interest to those who have to do with the utilization of water power as a public utility, is "The valuation of water power," by Mr. W. J. Hagenah.

## THE VALUATION OF WATER POWERS.

By WILLIAM J. HAGENAH,
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### INTRODUCTORY.

The paper herewith submitted contains an analysis of data bearing on the valuation of water powers devoted to public-utility uses. That a utility owning hydroelectric properties is entitled to earn a reasonable return on the value of its physical structures is well settled. What allowance, if any, is to be made for the value of the water right, or that element of value which accrues from the beneficial use of the water for power purposes, is not so clear. It has been maintained by some students of the public-utility question that since water powers are natural resources, the value arising out of the use of the power should not be capitalized by private interests, but should accrue entirely to the benefit of the public through reduced rates, the return to private capital being limited to a fair earning on its actual investment.

Water-power values can not be recognized as proper in one industry and denied in another industry. That water powers have a value in a commercial sense for manufacturing purposes has been established through many decisions.

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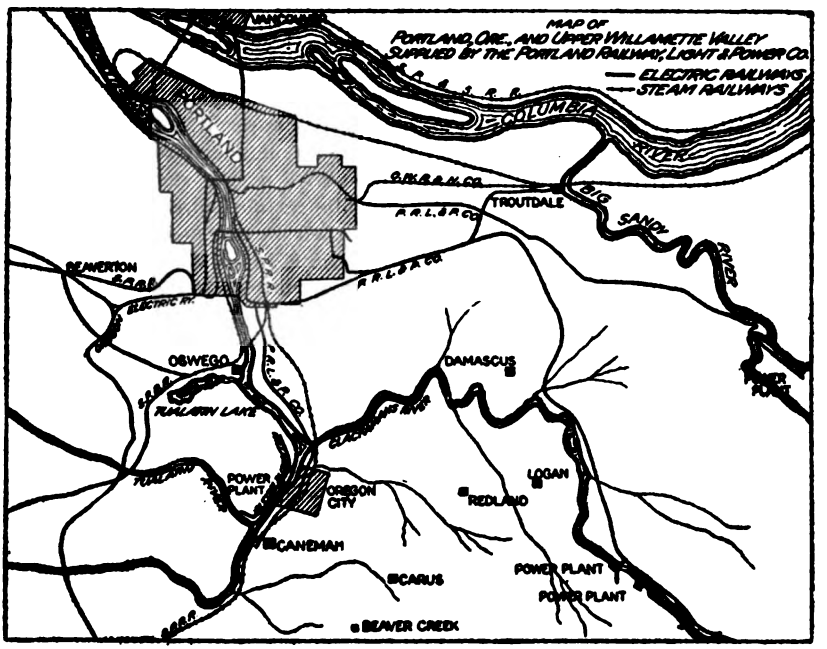
Based on this fact, it would be possible for a public utility, if its earnings are to be restricted to a fair return on the investment in physical plant alone, to dispose of those powers which it has been using for generating purposes to industrial interests which under the law are entitled to earn a return on such property, the utility in that event returning to the steam-power method of generation. Such a transfer of a successful water power would be to the detriment of the public because of the resulting necessity for an increase in the utility rates to cover the generally higher costs of steam-power operation. If a rate increase is certain under a change from hydraulic to steam-power generation, the public would be placed in a less favorable position by causing such a transfer than if the water power were considered as a part of the utility property and some allowance made for its value. The real difficulty has always been encountered in arriving at a fair value of such property. To compute the value of a water power entirely on the basis of its economical operation as




compared with the cost of steam-power generation in a district where fuel is expensive would be as unjust to the public as an attempt to appraise the value of coal deposits on the basis of water-power production costs in a district where water powers are scarce and of uncertain value. In either case a community would receive no more benefit from its natural resources than if it were less favorably located. The problem which therefore arises is the determination of some basis of valuation which is predicated on practical conditions and in which both the public and private capital are given such proportion of the value of the natural resource as these conditions themselves prescribe.

It is attempted to present herein some of the conditions and limitations which affect such value and which also serve as a basis for its apportionment. The data submitted have been compiled from studies of power costs and values for three of the largest utility systems in the Northwest—the Portland Railway, Light & Power Co., the Pacific Power & Light Co., and the Montana Power Co. The existence of these companies is founded on water powers, not



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random developments in a mountainous country where water power is abundant, but on the result of many developments linked together into single systems where each power unit through its natural characteristics or form of development serves to reinforce the other, making possible by means of low power costs the development of great industrial, utility, and transportation enterprises. The method set forth is not offered as a means for determining values with mathematical accuracy by means of formulæ. The paper is rather a discussion of certain economic and technical considerations affecting the values of such properties and some general conclusions which the application of such principles indicates. As an example of the practical application of such data and reasoning there have been assembled in this paper the facts bearing on the value of the water powers which supply electrical energy for lighting, power, and transportation purposes in Portland, Oreg., and in the greater industrial section of which that city is the center.

The result arrived at through the application of such method does not prove the exact value of the water powers. It does, however, tend to show the existence or nonexistence of a value in such property over and above the value of the physical structures alone, and when all the commercial and economic factors affecting the specific plant are considered, the result indicates to a considerable extent a measure of such value which is not unreasonable. The analysis of all the facts bearing on such properties readily shows that not all water powers are valuable, but rather that while certain powers may for many years offer no great inducements looking to their development, other powers are of proven worth and possess a substantial value in addition to the value of the physical plant, whether devoted to transportation, industrial or public utility uses.

## BASIS OF VALUATION.

The value of a water power, considered in its entirety, embraces two classes of property—namely, the physical plant and the rights and privileges arising out of and incident to the use of the water brought under control. The former class of property embraces land, buildings, dams, flumes, equipment, etc. The latter class embraces those elements of value which arise from the right to apply to practical uses the potential energy of such water, which energy was imparted to it through natural conditions but developed and enhanced by artificial means. The value of the former class of property can be ascertained from an appraisal, but the value of the latter class, embracing no portion of the physical plant and generally representing in a commercial sense a distinct and valuable asset, must be determined from a consideration of the economic and industrial conditions which surround and affect the use of such developed energy.

No part of the value of the water powers herein determined is predicated on the theory of private ownership. It is assumed at the outset in this analysis that the title to the physical water is not vested in the owners of the physical structures, but that such owners possess only the right to use it for purposes of converting the potential energy possessed by the water at an elevation into mechanical energy and thence into electrical energy. No water is consumed in the process of such conversion and where the right to use it for the purpose of power development has been legally obtained from the ultimate owner no property rights are infringed. The water in passing through the development works and converting equipment of a hydroelectric plant retains all the elements which it possessed before leaving its natural bed and loses nothing but its potential energy which, if the water had not been diverted, would have been dissipated in its fall in the natural channel between the point of diversion and

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the place where it is restored to the lower level basin. The physical plant necessary for the development and conversion of this energy to a form commercially available represents a large investment with heavy annual fixed charges and with specific items of expense for current operation. The commodity produced or service supplied from a profitable hydroelectric plant as a result of this process of conversion possesses a value which, as a general rule, is greater than that based solely on the theoretical "cost of production plus a reasonable profit." The existence of such a distinct value and the measure thereof may be determined from the fundamental facts pertaining to the nature of the property and the principles which govern and limit the actual use of its product in service.

### LAW OF SUPPLY AND DEMAND AS AFFECTING POWER DEVELOPMENTS.

The price and value of any commodity or product the supply of which is limited by natural forces is determined largely by the law of supply and demand. Under normal conditions, when the demand is stable the price of the product varies inversely with the supply. Likewise, with a fixed supply the price will vary directly with the demand. Where both the demand and the supply are to a large extent capable of definite determination and prices move freely in response to economic laws, there is created a more or less stable basis for transactions and through the meeting of the minds of traders on the different levels of bargaining there is created a "market" for such commodities or products which is definite and certain. A market in the broadest sense wherein the law of supply and demand has free play is not materially affected by the individual mind nor appreciably influenced by the single average transaction, but, being founded on the operations of all traders in such field, it reflects rather the composite mind and the volume of trade, and from such a market wherein elements which appear large in single transactions are given their due weight in the aggregate there is established the determining factor of "market price." This market price for any commodity may be either unstable and subject to quick and important changes, as, for example, the price for grain, provisions, securities, and money itself, or it may be comparatively stable and experience only a few changes each year, as, for example, the market price for coal, lumber, pig iron, and labor. Even more stable is the market price for certain agricultural lands, rents, transportation, and light and power. The market price is most sensitive for the basic or primary objects of trade, such as money, grain, and provisions, which respond quickly to the many intricate factors affecting either the supply or the demand. The market price for lands, rents, transportation, and power, these being resultant objects or commodities of trade, is less sensitive because of the remoteness of such price from the price for the basic or constituent elements entering into such commodities or services and also because of the provisions for intermediate profits and allowances for contingencies, all of which absorb the minor fluctuations, with the result that the prices for the resultant commodities or services respond more generally to the major cycles of trade. In every event, whether the market be sensitive or stable, the price for the commodity or product is ultimately determined largely by application of the law of supply and demand.

When the price of a product or service is determined by the law of supply and demand, the value of the source of that product or service is founded largely on the effect of such law. If the demand for any service is extensive and continuous so that the machinery of production can be operated under favorable conditions, the resulting profit will tend to increase and ordinarily will be large, with the result that the value of the machinery of production will

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also be enhanced, but if the demand is so low that the plant can be operated only a few hours each day or a few months each year, the cost will be greater and distribution retarded, and, as a result, the value of the source of production will be diminished. These facts, under normal conditions, determine the cost and the value of the majority of the items of commerce, affecting in the same general manner articles of food supply and forms of service. A tract of land capable of yielding annually 30 bushels of wheat per acre is more valuable than another tract similarly situated but capable of producing only 15 bushels. However, the former tract would be of less value if it were capable of producing its normal crop only in alternate years. In that event the average annual production would govern its value. A coal mine which can produce coal at a cost of 40 cents per ton is more valuable than a mine of equal size and producing the same grade of coal but showing total operating costs of 70 cents per ton of output. Likewise, of several power plants similarly located and having the same capacity, the one which can produce power at the lowest cost will gain the broadest market and be the most valuable. The value of a wheat field, the value of a mine, or the value of a power facility, depends therefore to a large extent on the output cost at which its product can be made ready for shipment or transmission to the market.

The price of commodities and the value of the sources of production are not founded solely on costs of production. Wheat raised under conditions which permit of its profitable sale at a price of 45 cents per bushed tends to reduce the price for all wheat, even though the general market price is quoted at 90 cents per bushel. The influence of 100,000 bushels of wheat grown at a very low cost is obviously small in a generally high market, but if instead of 100,000 bushels there were raised under these conditions a crop of over 100,000,000 bushels, the price of all wheat would decline and possibly, if the crop were large enough, to so low a level that certain wheat grown under much less favorable conditions could be sold only at a loss, with the result that the land formely devoted to the production of high cost wheat would be cultivated for other purposes. Similarly the coal which, because of its exceptional quality or the thickness of the vein or freedom from water interruptions, can be mined at much less per unit than the average cost of mining coal, tends to reduce the selling price for all coal. Where the quantity available at such low cost is negligible as compared with the normal demand, the influence of such low cost operations is without apparent effect on the market as a whole, but if the mine were to produce over 50,000,000 tons per year, the market price of coal would drop. The market price is therefore affected not only by the cost of producing the item, but by the amount or volume of the product which is available at such price.

In addition to being dependent on the output cost of its product and the volume of such product, the value of any machinery of production depends also on the accessibility of such property, for it is the availability of transportation or transmission facilities which determines to a large extent the final cost of the product at the point of consumption or use and therefore its effect on the general market price. Referring again to the example of the wheat land and the coal mine, the land and the mine will be less valuable if they are located many miles from the market for their products. In such event the cost of transportation is an element in the final cost of the product and it is the cost including transportation which determines its selling price. Other elements being equal, the parcel of land or the mine nearest to the point of consumption of its product is the most valuable, and the farther the source of production is removed from the market or the more expensive the process of transmission, the more is its value reduced because of this condition.

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Summarizing the factors which influence property values, it is obvious that the price of any commodity, product, or service and the value of the machinery of production from or by means of which it is produced or rendered, depend under conditions otherwise equal on the law of supply and demand, the principal factors affecting the application of such law being the cost of production, the productive capacity of the property, and its location with respect to the general market.

While the foregoing analysis has been made to apply particularly to wheat and coal, it also applies to power. The price of power and the value of its machinery of production is determined by the "market for power"—that is, the demand for power and the supply available to meet such demand. While the market prices for wheat and coal are determined by factors far-reaching and world-wide in their extent, the market for power, although somewhat different in nature, responds to the elements which affect markets generally in so far as they apply locally within the territory wherein distribution is economically possible. Just as wheat may be supplied for the world's market from land which is very fertile or of poor soil with a low average yield and from localities requiring a long freight haul or from land favorably situated with respect to deliveries, all of which in the world's primary markets determines the price of wheat through a balancing of the favorable and unfavorable factors affecting the final price, so power for any community may be generated by means of the energy of heat, or by gravity, such power being generated either at the point of use or at remote places and transmitted to the local market, the extent of which is determined by the radius of economical distribution. Heat in turn may be generated from various kinds of fuel, such as coal, wood or oil, the kind of fuel used depending upon the cost at the different points of use and the quantities available at such cost. Instead of developing and converting the energy of heat, power may be generated by converting the energy of falling water, but the development of such water power depends on the market conditions for power—that is, the supply and the demand. The development of a hydraulic power will not be undertaken if the power can not ultimately be sold in the available market at a profit. If the prospective development is large and the cost of the power low, the influence of such power in gaining a market will tend to reduce, to the extent of its capacity, through direct and potential competition, the cost of all power in the same general market. If, however, the cost of such power would be greater than the general market price for power, the development would not be undertaken, since power generated by cheaper processes would be purchased in preference and such market price would be unaffected by the existence of the undeveloped water powers.

Whether or not a hydroelectric development will be undertaken depends, therefore, on the market for power in which such development will compete and in this market there contend such factors as the character of fuel available, the quantity of the different kinds of fuel adaptable for power purposes, and the cost of such fuel delivered at the point of consumption, these factors being present whether the fuel be coal, oil, slabwood, or sawmill refuse. The power market is also affected by the cost of labor, power-plant land and buildings, generating and transmission equipment, etc. If all these factors entering into the cost of power cause the market price of power to be high and if there is at the same time a large demand for power, a hydroelectric plant which can supply a part of such demand at a profit to itself in excess of a sum deemed reasonable in view of the inherent hazards of the industry will possess a value greater than the value of its physical property alone. If, however, the existing market price is lower than the cost of the product of such

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prospective hydroelectric plant, the development would have no practical value for power purposes and under such conditions the investment would never be made, or if made, would result in losses to those who undertook the development.

As the value of the wheat lands and the coal mine referred to depended largely on the accessibility of such properties, so the value of a hydroelectric development depends in part on the availability of such power in the market. If a long and expensive transmission system must be maintained, the hydraulic plant is less valuable than if located directly in the power market where the costs per unit of output would consequently be lower. The lower the cost of its product the better would it be able to compete in such market where, through these lower costs, it would influence the general market according to the amount of power it could supply.

The value of specific machinery for power production depends also on the continuity with which the market can be supplied. In the power market time is the essence of the service and any source of power which can not meet an instantaneous or a long-sustained demand is for that reason less valuable, and through the operation of economic forces is relegated to serve classes of demand where the element of time is not so important and the service therefore less valuable. A hydroelectric plant which because of its water conditions is able to operate only 8 or 10 months per year and must have a steam reserve plant for stand-by service is less valuable than a plant similar in size and location but capable of operating throughout the year. The final cost of such power must include both the fixed and the operating expenses of the stand-by service, with the result that if such cost were to exceed the market price for power, a hydroelectric development capable of only limited operation would not be so readily undertaken even though the cost of operation during the period of ample water supply would be very low. If, however, the final cost, including the expenses of the stand-by service and the transmission system, is still less than the general market price for power, such plant would be developed and its product would tend to diminish the price for all power according to its own cost and the amount of power available at such cost. If the output of such plant were small the market price for power would be little affected by the added competition, since the entire output would be taken by a few customers at a substantial profit to both the power-plant owner and the customer, but if the supply at such low cost were very large, the general market price would fall, with the result that the expensive forms of power generation would be unable to compete further in such market and would ultimately cease to operate.

Since power is the resultant product into which enter many elements of material and labor costs, transmission, stand-by service, etc., it is the market price which determines the value of the source of such product. The value of individual water powers depends therefore on the market value for power, the supply available from such developments and the cost at which it can be supplied. The cost of power in individual plants varies with the character of the plant and the movement of commodity and labor costs, while the demand for power varies with the character of industries and business conditions, but in the complex interrelation of industrial and economic forces the law of supply and demand determines many of the fundamental factors of cost and price and therefore also the value of those properties the products of which compete in such market. It is on these facts that a measure of the value of certain water powers may be founded, such value depending on the efficiency of the plants and their capacity to meet the demands of the power market.

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POWER FACILITIES OF UTILITY UNDER INVESTIGATION.

The Portland utility previously referred to owns 10 generating stations material to this study, of which 5 are hydroelectric and 5 are steam plants. The hydroelectric stations in use are located at various distances from the central market, necessitating the construction of transmission lines by means of which the current is brought to the various cities served, where it is reduced to the proper voltage and frequency for commercial use. Although by far the greater portion of the energy is produced by water power, these stations do not carry their normal load throughout the year, for during certain months water conditions are unfavorable, with the result that the company must rely to some extent on steam-power service, using cheap sawmill refuse for fuel. As a part of its productive equipment, the company operates throughout the year two of the steam-power plants, the remaining steam-power equipment being held in reserve. The hydroelectric stations and the steam-power stations are connected with one another and with the substations by transmission lines and tie lines, so that the load of the entire system may be carried by such combination of power facilities as water conditions show to be most economical or advisable.

CENSUS OF POWER DEVELOPMENTS AND ANALYSIS OF COSTS.

In order to arrive at the market value for power in the district served by the above hydraulic developments, a detailed power census was made and every power plant was analyzed, tabulations being made to show the nature of the business operated, the character of plants in use, their rated capacity, and the load factor under which each normally operated, not only for the industries in Portland but also in the other localities reached or capable of being reached by the lines of that company. The Portland power market is diversified in character, the demand being supplied by isolated stationary plants in manufacturing establishments, by distribution from central stations to factories and street and interurban railways, and by locomotives. The isolated stationary plants are principally steam-power plants, but there are a number of hydroelectric stations devoted to industrial uses which in the aggregate develop a large amount of power. The power consumers were classified according to the character of power used, whether steam or hydraulic power, and each class was further grouped according to fuel and power conditions.

Steam locomotives and interurban electric locomotives and cars were included in this analysis because they represented distinct classes of power consumers. A considerable portion of the transportation industry in this territory is operated by electricity supplied by the hydraulic powers in question and to that extent is a present factor in the cost of electric power. The railway requirements are constantly increasing, additional lines having been electrified since this study was concluded. The number and capacity of the steam locomotives in normal service constituted a factor in determining the market price of power, as well as the corresponding data for factories and mills, for unless electric power can be supplied on a basis more favorable than the cost of steam operation, railways, like stationary power plants, will offer no field for electrification. The average number of locomotives in service in the territory under review was obtained from the mechanical departments of the railroads operating in such territory, from which sources was also obtained the information as to their classification, tractive effort, boiler-heating surface and operating and maintenance cost for each class of locomotives. The extent of the demand for power and the character of the power-producing agencies as determined from the power census referred to are shown in the table below:

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*Summary of power demand and source of supply.*

I. STATIONARY STEAM POWER PLANTS.

| Character of fuel. | Number of plants. | Capacity expressed in terms of kilowatts. |
|---|---|---|
| *Portland division.* | | |
| Mill refuse | 28 | 17,410 |
| Slab wood | 46 | 2,967 |
| Coal | 6 | 196 |
| Oil | 40 | 7,832 |
| Total | 120 | 28,405 |
| *Vancouver division.* | | |
| Mill refuse | 7 | 511 |
| Slab wood | 3 | 246 |
| Oil | 2 | 560 |
| Total | 12 | 1,317 |
| *Willamette Valley division.* | | |
| Mill refuse | 5 | 1,281 |
| Slab wood | 19 | 895 |
| Oil | 2 | 34 |
| Total | 26 | 2,210 |
| Total, all divisions | 158 | 31,932 |

II. ISOLATED HYDRAULIC POWER PLANTS.

[Other than those owned by P. R. L. & P. Co.]

| | | |
|---|---|---|
| Paper and pulp mills | 4 | 29,780 |
| Minor industrial plants | 2 | 872 |
| Public utility plants | 3 | 512 |
| Total | 9 | 31,164 |

III. STEAM POWER LOCOMOTIVES.

| | Average number of locomotives. | Rated capacity in kilowatt equivalents. |
|---|---|---|
| Great Northern Railway | 4 | 2,949 |
| Northern Pacific Railway | 8 | 7,606 |
| Northern Pacific Terminal Co | 9 | 8,958 |
| Oregon-Washington Railroad & Navigation Co | 71 | 72,490 |
| Southern Pacific Co | 54 | 43,650 |
| Spokane, Portland & Seattle Railway | 32 | 22,125 |
| Total | 178 | 157,788 |

IV. PORTLAND RAILWAY, LIGHT & POWER CO.

Developed capacity of company in kilowatts, 62,280.
Total power, all sources, 283,164.

According to the above table the total demand for power in the district called for a developed capacity of 283,164 kilowatts. This demand originated from 158 isolated and stationary steam power plants with an aggregate capacity of 31,932 kilowatts, and from 9 isolated hydraulic power plants with a combined capacity of 31,164 kilowatts. Transportation companies operating in this district required 178 locomotives with a power capacity, expressed in terms of electrical units, equal to 157,788 kilowatts. The utility customers demanding energy for lighting, power and transportation purposes required an installed capacity of 62,280 kilowatts.

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I. STATIONARY STEAM POWER PLANTS.

Since the above demand arises from a great variety of sources and is supplied under widely different conditions, the true market price of power for this region is indicated by the weighted average of such diversified production and costs, in which computation the character and the extent of production in each case are given due weight. The data necessary for such a computation were obtained from the power census referred to and the computed unit costs. In order to reduce these costs to a common basis for comparative purposes, the power output of all plants was computed in terms of kilowatt hours. Since stationary steam power plants, in addition to the output of power, produced a by-product in the form of exhaust steam available for heating purposes, a credit was given for the value of such exhaust steam which, according to the facts examined, amounted to an average of 25 per cent of the cost of producing the energy.

The detailed operating expenses of the companies embraced in such power census were grouped into five general accounts—namely, "fuel," "labor," "oil and other supplies," "maintenance," and "fixed charges," and the costs were computed for each class of plants according to the financial and operating data determined from the cost studies made. The detailed cost items relied on in such data appear below.

*Fuel.*—In those industries where oil was used for fuel purposes, the local price of 90 cents per barrel was used. One pound of this grade of fuel evaporates 13 pounds of water and 1 barrel evaporates 4,100 pounds of water. On this basis, 1 barrel of oil generated approximately 82 kilowatt hours at a fuel cost of 1.125 cents per kilowatt hour.

Mill refuse, the price of which was 75 cents per 200 cubic feet, was used for fuel in many mills and manufacturing plants. Such fuel sufficient to generate 1,000 pounds of steam will cost at the above price 7.6 cents, or 0.38 cents per kilowatt hour. Assuming the cost of $1.00 per unit of mill refuse for manufacturing plants, to which industry the fuel is more expensive because of the delivery charge, the cost per kilowatt hour on the above basis was 0.507 cents.

The cost of slab wood for fuel purposes varied with the length of cartage, ranging from $1 to $3.50 per cord, or an average cost of approximately $2 per cord for the amount so used. This fuel will generate 1,000 pounds of steam at a cost of 18 cents, or 0.9 cent per kilowatt hour.

Western lignite coal of 10,000 B. t. u. heating value ranged from $5 to $10 per ton delivered, with an average price of approximately $7. Steam to the amount of 1,000 pounds can be generated by such fuel at a cost of 48.4 cents, or 2.42 cents per kilowatt hour.

*Labor.*—The allowance for labor in the cost of power for the steam plants varied with the size of the plant and the load factor. The wages of all station men were computed on the basis of the prevailing scale of compensation for power-plant, boiler-room, and engine-room employees in both large and small plants. The following table shows the average number of employees necessary for the different plants under the various load factors:

| Capacity of plant (kilowatts). | Number of employees required at different load factors. | | |
|---|---|---|---|
| | L. F. 30. | L. F. 50. | L. F. 80. |
| 50 | 1 | 2 | 2 |
| 100 | 1½ | 3 | 4 |
| 300 | 2 | 4 | 5 |
| 500 | 3 | 5 | 6 |

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*Oil and supplies, maintenance.*—The allowance for these items of expense was obtained from a study of the actual operating records of many plants included in the study referred to.

*Fixed charges.*—The fixed charges embraced in the operating costs varied with the investment, which was determined from a study of many plants ranging from very small stations to those of large capacity. Based on the investment values and operating costs, there was included in the costs of power an annual charge for general expenses, taxes, and insurance, 6 per cent for depreciation and 8 per cent as a return on the investment.

The following table shows the net cost per kilowatt-hour of power produced by steam, using the different classes of fuel enumerated and operating under different load factors, which results were used as the basis for determining the average cost of producing power by means of steam in this market:

*Total cost of power in cents per kilowatt hour.*

| Load factor. | Plant capacity. | | | |
|---|---|---|---|---|
| | 50 kilowatts. | 100 kilowatts. | 300 kilowatts. | 500 kilowatts. |
| Oil: | | | | |
| 30 | 2.140 | 1.950 | 1.643 | 1.626 |
| 50 | 1.954 | 1.760 | 1.443 | 1.390 |
| 80 | 1.743 | 1.524 | 1.261 | 1.216 |
| Mill refuse: | | | | |
| 30 | 1.582 | 1.392 | 1.083 | 1.067 |
| 50 | 1.392 | 1.200 | .884 | .833 |
| 80 | 1.184 | .966 | .702 | .658 |
| Slab wood: | | | | |
| 30 | 1.970 | 1.780 | 1.471 | 1.457 |
| 50 | 1.783 | 1.590 | 1.274 | 1.226 |
| 80 | 1.574 | 1.356 | 1.092 | 1.047 |
| Coal: | | | | |
| 30 | 3.113 | 2.923 | 2.614 | 2.597 |
| 50 | 2.924 | 2.730 | 2.414 | 2.363 |
| 80 | 2.714 | 2.498 | 2.233 | 2.188 |

The following table shows such cost data for the stationary steam-power plants grouped according to their capacity, fuel conditions, and load factors, and also the power produced during a period of 12 months, the cost per unit of power under the conditions applying to each class, and the weighted average cost for all power produced in such plants:

*Sources, demand, and cost of power, stationary steam plants, in territory reached by Portland Railway, Light & Power Co.*

| Plant classification, kilowatt capacity. | Number of plants. | Nature of fuel. | Load factor. | Rated capacity, in kilowatts. | Power consumed during year in terms of kilowatt-hours. | Cost per kilowatt-hour. | Total cost of power. | Average cost per kilowatt-hour. |
|---|---|---|---|---|---|---|---|---|
| 0–75 | 14 | Mill refuse. | 30 | 399 | 1,048,572 | $0.0158 | $16,599 | ..... |
| 0–75 | 1 | ...do..... | 50 | 75 | 328,500 | .0139 | 4,578 | ..... |
| 75–200 | 6 | ...do..... | 30 | 887 | 2,331,036 | .0139 | 32,446 | ..... |
| 75–200 | 2 | ...do..... | 50 | 164 | 718,320 | .0120 | 8,621 | ..... |
| 200–400 | 2 | ...do..... | 30 | 522 | 1,371,816 | .0108 | 14,807 | ..... |
| 400 and over | 7 | ...do..... | 30 | 6,664 | 17,512,992 | .0107 | 186,859 | ..... |
| 400 and over | 8 | ...do..... | 50 | 10,491 | 45,950,580 | .0063 | 382,712 | ..... |
| Total | 40 | ..... | ..... | 19,202 | 69,261,816 | ..... | 646,682 | $0.0093 |
| 0–75 | 6 | Coal..... | 30 | 196 | 515,068 | 0.0311 | 16,037 | 0.0311 |

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*Sources, demand, and cost of power, stationary steam plants, in territory reached by Portland Railway, Light & Power Co.*—Continued.

| Plant classification, kilowatt capacity. | Number of plants. | Nature of fuel. | Load factor. | Rated capacity, in kilowatts. | Power consumed during year in terms of kilowatt-hours. | Cost per kilowatt-hour. | Total cost of power. | Average cost per kilowatt-hour. |
|---|---|---|---|---|---|---|---|---|
| 0-75 | 55 | Slabwood. | 30 | 1,321 | 3,471,588 | 0.0197 | 68,533 | ..... |
| 75-200 | 9 | ...do..... | 30 | 1,059 | 2,782,052 | .0178 | 49,604 | ..... |
| 200-400 | 2 | ...do..... | 30 | 448 | 1,177,344 | .0147 | 17,356 | ..... |
| 400 and over | 1 | ...do..... | 30 | 474 | 1,245,672 | .0146 | 18,154 | ..... |
| 400 and over | 1 | ...do..... | 50 | 806 | 3,530,280 | .0122 | 43,169 | ..... |
| Total | 68 | ..... | ..... | 4,108 | 12,207,936 | ..... | 196,816 | 0.0161 |
| 0-75 | 22 | Oil..... | 30 | 768 | 2,018,304 | 0.0214 | 43,192 | ..... |
| 0-75 | 1 | ...do..... | 50 | 48 | 210,240 | .0195 | 4,105 | ..... |
| 75-200 | 11 | ...do..... | 30 | 1,177 | 3,093,156 | .0195 | 60,345 | ..... |
| 75-200 | 4 | ...do..... | 50 | 621 | 2,719,980 | .0176 | 47,848 | ..... |
| 200-400 | 2 | ...do..... | 30 | 564 | 1,482,192 | .0164 | 24,348 | ..... |
| 200-400 | 1 | ...do..... | 50 | 298 | 1,305,240 | .0144 | 18,837 | ..... |
| 400 and over | 1 | ...do..... | 30 | 448 | 1,177,344 | .0163 | 19,139 | ..... |
| 400 and over | 2 | ...do..... | 30 | 4,502 | 31,550,016 | .0122 | 383,705 | ..... |
| Total | 44 | ..... | ..... | 8,426 | 43,556,472 | ..... | 601,519 | 0.0138 |
| Grand total | 158 | ..... | ..... | 31,932 | 126,541,312 | ..... | 1,461,054 | .0116 |

From the data above presented it appears that the cost of power generated by mill refuse for 40 plants with a capacity of 19,202 kilowatts ranged from 0.83 cent to 1.58 cents per kilowatt hour according to the load factor and capacity of the plant, the weighted average of all power generated in this manner being a cost of 0.93 cent per kilowatt hour. In a similar manner the cost of generating power by means of coal for fuel in 6 plants was 3.11 cents per kilowatt hour; for power generated with slab wood for fuel in 68 plants having an aggregate capacity of 4,108 kilowatts the weighted average cost was 1.61 cents per kilowatt hour; and for the 44 plants of 8,426 kilowatt capacity using oil for fuel the weighted average cost was 1.38 cents per kilowatt hour, ranging from 1.22 cents to 2.14 cents per kilowatt hour according to the load factor. The weighted average cost of all power generated by steam in the 158 stationary steam plants with a capacity of 31,932 kilowatts was 1.16 cents per kilowatt hour.

### II. ISOLATED HYDRAULIC POWER PLANTS.

In addition to the stationary steam power plants and aside from the developments of the utility company under investigation, there were a number of plants operated by hydraulic power, the product of which was used in industrial establishments and for public service uses. Such plants, to the extent of their output and costs, likewise influenced the general market for power. By far the greater amount of power produced by these stations was consumed in the manufacture of pulp and paper. These mills represented the largest class of power consumers in the territory in question and with the abundant supplies of raw material their steadily increasing demand could easily absorb the entire output of several of the largest hydroelectric developments now devoted to the public service, should such developments be made available for industrial uses exclusively. Other classes of manufacturing plants consumed the output in whole or in part of smaller water powers. In general, these plants were located at the power sites where no transmission and substation expenses entered into the cost of their power.

Since the operation of the above stations affects the market price of power, an investigation was made to determine their capacity and costs. Such exami-

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nation disclosed a total of nine hydraulic powers in service with an aggregate capacity of 31,164 kilowatts, of which number, however, only four plants were sufficiently large to appreciably influence the general market, and only a portion of the output of one of these stations entered the market over a transmission system. The costs to be applied to such hydraulic-power generation for private uses were computed from facts affecting the investment, operating costs, depreciation, and load factor. Since these plants adjusted their operating necessities to the variation in the stream flow, and also because no transmission was necessary, the cost of hydraulic power in plants located at the power site was exceedingly low. The yearly output of the above nine stations was determined to be 98,411,770 kilowatt hours, for which the average cost was computed to be 0.504 cent per kilowatt hour.

### III. STEAM-POWER LOCOMOTIVES.

In arriving at the capacity of the steam locomotives operating in this district and their influence on the costs and value of power, the locomotives were considered in a manner similar to stationary power plants, it being assumed that instead of delivering power to a generator or to line shafting the power is delivered to the drive wheels, and the load, instead of being pulled through gearing or belting, is carried directly on the drive wheels. It is not the purpose of this computation to determine the relative efficiency of steam power as opposed to electrical power in the transportation field, but rather to show what the demand for power from such industry actually was and, therefore, what possible market was afforded through the further electrification of transportation lines.

The work required of a steam locomotive is similar to that required of a stationary steam engine and is based on the number of foot-pounds which the locomotive can deliver at its drive wheels. The actual performance of a locomotive varies greatly in accordance with the conditions under which it operates and the class of service in which it is engaged. It was impossible to compute the actual power production during the year in question for each of the locomotives listed, but they were classified according to the type of the units, and the performance of each locomotive was based on the average record for each class. The bases on which such classifications were made were obtained from the records of railway mechanical departments, with the cooperation of representatives of locomotive manufacturers, and are the results of practical service operations and tests made to determine the capacity and efficiency of different types of locomotives under the conditions prevailing in the territory in question.

The performance required of locomotives consists in starting trains and in overcoming resistances against traveling at high rates of speed. The draw-bar pull is greatest at the starting point and diminishes as the speed increases until the air resistance resulting from high speeds causes it to increase again. The draw-bar pull is a measure of the horsepower developed and as such pull increases the horsepower of the locomotive increases until the capacity of the unit is reached.

The general formula for determining the horsepower of a locomotive is as follows:

$$\frac{P \times L \times A \times N}{33{,}000} = H.P.$$

P=mean effective pressure in pounds per square inch.
L=length of stroke in feet.
A=area of piston in square inches.
N=number of strokes per minute.

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By cancellation and substituting the diameter of the drive wheels the formula may be restated as follows:

$$\frac{C^2 \times S \times P \times MPH}{D \times 375} = H.\ P.$$

C=diameter of cylinder in inches.
S=length of stroke in inches.
P=mean effective pressure at given speed.
MPH=miles per hour.
D=diameter of drive wheels in inches.

The determination of the horsepower may be simplified by the adoption of the following formula:

$$\frac{T \times M}{375} = H.\ P.$$

T=tractive power in pounds.
M=miles per hour.
375=constant.

The formula for the tractive power of a single expansion locomotive is:

$$\frac{C^2 \times S \times P}{D} = T$$

For a four-cylinder compound locomotive the tractive power is as follows:

$$\frac{C^2 \times S \times 2/3P}{D} + \frac{C^2 \times S \times 1/4P}{D} = T$$

C=diameter of cylinders in inches.
S=stroke of piston in inches.
P=mean effective pressure in pounds.
D=diameter of drive wheels in inches.

Adopting the above formulæ, the rated horsepower of the 178 locomotives was determined through the substitution of the classified data referred to. A speed of 15 miles per hour was accepted, that speed being shown by steam indicator cards to be the point at which the maximum horsepower was developed, and the mean effective pressure was taken at 85 per cent of the working pressure. Based on these computations, the results indicated a rated horsepower for locomotives of 211,436, or 157,788 kilowatts. Not all of this indicated power, however, if ever developed, would be long sustained. Records of locomotive performances under normal conditions in service showed that the developed power was approximately 60 per cent of the rated capacity and that the load factor of such power units was approximately 21 per cent, so that the actual power developed by the above locomotives during the twelve months' period may be placed at 174,198,320 kilowatt hours.

With an exception relatively insignificant, the above locomotives were of the oil-burning type, using a grade of fuel oil, which, in ordinary service, requires 2 pounds of oil per actual horsepower hour. The wholesale price of such oil in large quantities ranged from 72.5 cents to 74 cents per barrel of 315 pounds delivered, but the cost was not less than 78 cents per barrel at the locomotive burner. On the above basis of 2 pounds of oil per horsepower hour, 6.36 barrels would be consumed per 1,000 horsepower hours, or 8.52 barrels per 1,000 kilowatt hours, representing a cost of $1,157,650.

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Operating records of locomotives in the territory under review showed an operating labor expense of approximately $3,000 per locomotive per year, or a cost of $534,000 for the units embraced in the summary above. The maintenance cost averaged $2,500 per locomotive per year, or a total of $445,000.

A classification of the locomotives and their market prices showed an approximate investment of $4,094,000, or an average cost of $23,000. The taxes, insurance, and general expenses assignable to this investment were placed at 2 per cent per year, depreciation at 5.5 per cent and the return on the investment at 7.5 per cent. Computed on the investment devoted to this form of power, the general expenses and fixed charges were $3,450 per locomotive, or a total for the year of $614,100. The total cost of power generated by locomotivs in the Willamette Valley market was therefore $2,750,750, or 1.58 cents per kilowatt hour.

### IV. POWER SUPPLIED BY UTILITY COMPANY.

The amount and cost of the power supplied by the public utility company was determined from its operating records. In computing the measure of the value herein described, the cost of the power produced by the company was credited with the natural advantages accruing from the operation of the hydraulic powers and in turn was charged with expenses incident to the unfavorable features pertaining thereto. Since the hydraulic powers are located at a distance from the market where their product is disposed of and not being of such a character as to furnish continuous service throughout the year, there was charged against the power investment not only the land, buildings, hydraulic development works, and equipment used directly in the generation of electricity, but also the investment in transmission lines and in steam-power auxiliary plants. The property devoted to the production of power as considered in this investigation was accepted as embracing the primary generating plant and equipment, and transmission lines, and the substation equipment to the point where the product of the utility was delivered in the same vicinity and under the same conditions which apply to the cost of producing power in isolated plants.

The value of that portion of the physical plant devoted to the production and delivery of power within the limits above described was based on an appraisal of the property, the reproduction cost new less depreciation being accepted as the "fair value" for the purpose of computing the cost of the power produced. The following table shows the valuation of the property of the several plants assignable to the cost of power:

| | |
|---|---|
| Land | $757,181 |
| Hydraulic power works | 5,116,560 |
| Buildings, fixtures, and grounds | 1,873,381 |
| Transmission lines | 579,557 |
| Power plant and substation equipment | 2,650,818 |
| Telephone system | 18,432 |
| Utility equipment, supplies, etc | 569,914 |
| Total | 11,565,843 |

Not all of the above property, however, was devoted to the production of power during the year under review. A portion of the investment at one station was properly assignable to industrial operations, and the newest station included in the total was in operation for a period considerably less than one year. Adjusting the data on the basis of such facts, the valuation chargeable against the cost of power is $9,273,319.

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The annual depreciation requirement with respect to the above depreciable property was determined on the 4 per cent sinking-fund basis, as follows:

| Classification. | Estimated reproduction cost, new. | Rate per year. | Annual requirement. |
|---|---|---|---|
| | | *Per cent.* | |
| Hydraulic power works | $3,517,022 | 0.22 | $7,737 |
| Buildings, fixtures, and grounds | 1,765,270 | 1.05 | 18,535 |
| Transmission lines | 553,676 | 3.3 | 18,271 |
| Station and substation equipment | 2,995,799 | 2.4 | 71,899 |
| Telephone system | 19,979 | 3.3 | 659 |
| Total | 8,851,746 | | 117,101 |

The switchboard cost of power of the utility company as computed from the records and accounts of the company for the period in question was $210,365.28. This is the cost at the substation switchboards, or the point of distribution or delivery in the market center where this product meets the competition of the output from all other power-production sources. This cost is the "reservoir" or "pool" cost of the power, showing the expenses for the power system as made up of the primary hydraulic power plants and the reinforcing steam power plants as connected through the transmission system and includes the specific operating expenses for each generating station and each primary substation and the expenses of operating the transmission system.

The above amount, however, does not include all the expenses entering into the cost of power. Additions have been made to cover taxes and general expenses as computed from the books of the company. There was also included the estimated requirement for depreciation above referred to and an allowance for return on the investment at the rate of 8 per cent per annum. The total cost of generating and delivering power from this power system to the point of sale comparable with the stationary plants may be stated as follows:

| | |
|---|---|
| Switchboard cost of current at primary substations | $210,365 |
| Taxes | 113,583 |
| General expenses | 32,737 |
| Depreciation | 117,101 |
| Return on appraised value of physical property at 8 per cent | 741,865 |
| Total | 1,215,651 |

The total power delivered to the customers of the utility company at the above cost of $1,215,651 was 146,700,000 kilowatt hours, or a cost of 0.83 cent per kilowatt hour. The power delivered was used as the basis of the computations with the result that the current lost in transmission and primary conversion constituted a charge against this particular method and source of power production. It will be noted from the above that no use has been made of the company's rate schedule in determining the effect of this product in the general power market.

### TOTAL DEMAND AND AVERAGE COST OF POWER.

The following table summarizes the factors of supply and demand as they affect the power market and attaches to each such weight as its nature determines, the table showing (1) the total demand for power as indicated by the installed capacity to meet such demand, (2) the amount of power produced

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to meet the normal operating demand during the 12 months period, (3) the cost of producing and delivering the power to the place of use, and (4) the average cost of producing such power per kilowatt hour:

| Classification. | Number of plants. | Capacity in kilowatts. | Power consumed during year in kilowatt hours. | Total cost of power. | Average cost per kilowatt hour. |
|---|---|---|---|---|---|
| Stationary steam plants | 158 | 31,932 | 125,541,312 | $1,461,054 | $0.0116 |
| Locomotive power | 178 | 157,788 | 174,198,320 | 2,750,750 | .0158 |
| Isolated hydraulic plants | [1] 9 | 31,164 | 98,411,770 | 495,485 | .0050 |
| Portland Railway, Light & Power Co | [2] 1 | 62,280 | 146,700,000 | 1,215,651 | .0083 |
| Total | | 283,164 | 544,851,402 | 5,922,940 | .0109 |

[1] Not owned by Portland Railway, Light & Power Co., but operating in territory which it serves or is capable of serving.
[2] Interconnected hydraulic and steam power plants considered as a single plant.

The above table shows that the territory reached by the lines of the utility company calls for power service to the extent of 283,164 kilowatt capacity, and that the total power consumed during the twelve months period was 544,851,402 kilowatt hours. The average cost shown above for all the power produced is the weighted average, in which final result consideration was given to every source of power which was actually a competitive factor in such market, both as to the supply which it could furnish and the cost of such power to the consumer. The small efficient plant which produced power at a low cost influenced the final average cost to the full extent of its favorable factors. The economies which accrued from the hydraulic powers were effective in reducing the general market price for all power in such region to the extent of their capacity to supply cheap power. In the same manner the absence of cheap fuel in sufficient quantity to be a factor in a business sense has been a hindrance to the industrial development of the community, and this fact operated to increase the general market price for power to the extent that recourse must be had to expensive fuel for power purposes, since there was not enough water power developed to meet the entire demand. All plants, regardless of the source of the power produced, size of plant, and load factor, were reduced in the foregoing calculations to a common basis, and the final average was therefore the best available index of the general value of power in such market.

According to the above table, the weighted average cost of all power generated by means of steam in stationary plants was 1.16 cents per kilowatt hour. The weighted average cost of power produced by steam locomotives was 1.58 cents per kilowatt hour, while the average cost of power generated by the utility company and delivered in this power market was 0.83 cent per kilowatt hour. The weighted average cost of all power in such district was 1.09 cents per kilowatt hour. It will be observed that the cost of the power produced by the above company at its hydroelectric plants, reinforced by steam-power plants, was lower than the cost of power produced from any other source in this district, except hydraulic power where transmission lines were not required and steam power generated by mill refuse fuel in sawmills having high-load factors. Since mill refuse is a by-product of the sawmill industry and is consumed almost exclusively by such industry in the process of sawing and manufacturing lumber, the cost of such fuel to the mills is nominal. The industries using mill refuse fuel other than lumber manufacturing plants are almost invariably located so near to the sawmill that the cost of the fuel to such plants is but little increased by the cost of conveyance.

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In comparing the cost of power generated by the sawmills for their own use, consideration must be given not only to the cost of the mill refuse, which unless consumed by the mills would be a burden of expense to the companies, but also to the character of the power plants and the load factors under which they operate. The power plants of sawmills are as a rule cheaply constructed as to buildings and fixtures and can not be compared with power plants generally. The above analysis also shows that over 55 per cent of the total power produced by mill-refuse fuel is produced under a load factor of 50 per cent as compared with the load factor of the utility company, which is considerably less.

The high cost of coal, on the other hand, has made its use for power production in this district very costly and almost prohibitive, as is shown by the existence of only six small plants using such fuel. Expensive fuel and a very low load factor explain to a large extent the high cost of the locomotive power. Numerous investigations have demonstrated that particular forms of power production are best adapted to certain industries, but that the installation of the most efficient power service as suited to specific needs has not as yet been fully brought about in the Portland industrial territory was shown by the variation in power costs of competitive plants in the same field of industry. That different industries were gradually undergoing a readjustment of their power service in order more economically to meet their particular requirements was demonstrated by the number of changes each year in the power supply for industrial uses, in the course of which adjustment the more expensive forms of power production were being eliminated and the use of the lower cost facilities extended until they were absorbed and a new level of average costs and prices resulted. Under these influences the manufacturing and transportation industries of the northwest have been gradually changing to the use of hydroelectric power.

#### MARKET PRICE OF POWER AS DETERMINING VALUE OF SPECIFIC WATER POWERS.

The "power market" and the "market price" determine the value of the water powers owned by the Portland Railway, Light & Power Co. As previously described, the value of any machinery capable of producing a commodity or service for which there is a constant demand depends principally on the cost at which such commodity or service can be supplied and the amount of such output which can be produced. For commodities which are the subject of a more or less constant demand there is a definite and determinable market price which fluctuates according to the law of supply and demand. The value of coal mines varies with the major trend of coal prices; the value of agricultural lands varies with the trend in price of farm products; stumpage rises or falls in value in sympathy with the long term market for lumber. In the same manner, the value of fixed power producing machinery will vary with the market for power. In every case the value for any particular mine, farm, forest, or power property will depend, other things being equal, on the efficiency with which it can be operated with respect to the general market price, both in regard to the cost of operation and the volume of output, and the measure of such value is indicated roughly by the capitalization of the difference between the cost of its own product and the general market price of such product, delivery being made to the nearest market center.

Since the market price for power was 1.09 cents per kilowatt hour, the value of the particular water powers herein described under the then existing operating conditions depended (1) on the margin of saving between the established market price for power and the cost of power as produced by the facilities in question, and (2) on the amount of power which it could supply at such cost.



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Since the low cost of the power supplied from these developments was a factor in shaping the power market, influencing the general market price according to the cost and the amount of power available, the cost of power produced by the utility was included in the general weighted average, with the result that the difference between 1.09 cents per kilowatt hour and 0.83 cent per kilowatt hour represented the direct saving which accrued to the utility because of the natural advantages which it possessed. The company's operating records showed that it supplied 146,700,000 kilowatt hours under these conditions during the 12 months' period under review, which output, at a saving of 0.26 cent per kilowatt hour, was equivalent to a profit for such period of $381,420. Since this is an annual saving, increasing or decreasing with the development of the power market of Portland and vicinity, the value of such annual saving was approximately $4,767,750 when capitalized on the same basis of interest as was used in determining the cost of producing power in the steam plants, namely 8 per cent.

Under the above reasoning, the amount of $4,767,750 represents the value of the right to use the water for power purposes in the present state of the power developments and as charged with the investment in transmission lines and reserve steam-power plants. Specific conditions exist here, and they exist in nearly every case, which tend variously to increase or reduce such value. Such value would be increased in this instance if the power plants were developed to their maximum capacity and the product of such additions could readily be sold. In several stations additional water wheels could be installed at a comparatively small increased investment and the cost of service per kilowatt hour thereby still further reduced, with a corresponding increase in the value of the power facilities. This increase in value could also be accomplished in some cases by increasing the water storage facilities, with the result that the hydroelectric plants would be able to operate throughout the year and consequently would not be charged to so large an extent with the burden of reserve steam power stations. If, however, such added capacity were to replace the expensive power plants now operating as steam locomotives, and electric trains were to replace steam trains, the market price of power would be reduced because of the increased use of low cost power. This tendency to reduce the above value would in turn be offset in part by the fact that if the utility here under investigation were enabled to furnish much of the power which is now being produced at a somewhat higher cost than that at which the company could supply the demand, the cost to present customers would be reduced, since the fixed charges of the existing property would be distributed over a greatly increased output. Such reduced costs per unit of power, even though causing thereby a reduction in the market price of all power, would still reveal a considerable margin of saving as compared with the reduced market price of power, upon which saving the then value of the water powers would be predicated.

The value arising out of the use of the water powers in this district will tend to increase, because of the removal of the sawmill industry and with it the mill-refuse fuel with which it is now possible to generate power cheaply. The sawmills will not long be a factor in the Portland power market and the manufacturing industries now using mill refuse for fuel will be compelled to rely on other sources of power. With the present maximum development of the lumber industry all the mill refuse now produced is being consumed for power generation purposes. Even if all such cheap fuel in the entire Willamette Valley were made available for the Portland Railway, Light & Power Co., it would be far from sufficient to meet the ordinary power demands of that company.

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As against the influences which tend to sustain the valuation here determined is the possibility of the development of other water powers. Should the isolated steam power plants be supplanted in large part by hydroelectric power, and the electrification of transportation lines be materially extended, the market price for power would decline. This possibility, however, may easily be overestimated and can be considered only to the extent of undisputed facts. The existence of undeveloped powers does not materially influence the existing market, because of obstacles which must be overcome before power from such sources can be made available. Among such difficulties may be mentioned the uncertainty as to the final cost of the product of such prospective developments and the task of finding a market for the power. Whatever the power rates may be in any community, expensive hydraulic developments will not be undertaken unless it is reasonably certain (1) that at least an equally favorable rate can be offered and (2) that there is enough demand at the time or immediately in prospect to justify the venture.

The above-determined value of $4,767,750, or, in round numbers, $4,750,000, may be stated to be substantially the value of these water powers as parts of the complete interconnected system. Value is essentially a matter of judgment and can not be determined by mathematics alone, but analyses and computation may indicate in a general way some of the limits within which the value may vary according to the emphasis attached to specific sets of conditions. Each property must be analyzed on its own merits. It is entirely possible that a course of reasoning which seems proper in one case would not be equitable in another. In this respect the object sought may be open to as many avenues of approach as have been indicated by the courts in the more simple task of appraising the physical property of utilities. In this instance, the combined powers may be worth somewhat more or less than the above amount, but for most purposes that measure would be equitable to all parties. Expressed in terms of dollars per unit, this study showed a value of from $65 to $80 per horsepower, an amount which has frequently been paid for developed water powers in this district and is in accord with the basis on which power leases have been made. That it is also a fair measure of the amount to be allowed to a public utility under conditions as here shown is further indicated by the fact that a return on such a value can generally be obtained by private industries using such water powers in competitive enterprises and to which private uses these particular powers could legally be put.

The CHAIRMAN. The paper is now open for discussion.

Mr. MERRILL. I would like to ask Mr. Hagenah whether that valuation was made for rate-making purposes?

Mr. HAGENAH. Yes, sir.

Mr. MERRILL. It seems to me, from what I can understand of the paper as read, that it proposes a method of valuing a noncompetitive business on the basis that would be employed in determining the value of a competitive business, and, furthermore, that the method seems to proceed on the tacit understanding that existing rates are correct and that the values should be determined therefrom.

If I understood the statement at the beginning of the paper, it appears to proceed upon the assumption that water power was not owned by the utility company, but that the company had merely the right to use. It does not seem to me a correct method of reason-

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ing to compare a right to use under a license from the State or from the Federal Government, which I understand is the situation that exists, with the situation that would exist if the company owned the water rights in fee.

If the company owns the water rights and the land on which the plant is located, it has the privilege of securing what it can get for the property; and it seems to me that the method which Mr. Hagenah has presented here is rather a method which would be employed in a case of private sale, where one concern was inclined to dispose of its property to another concern, and where the market value is the determining value. But in my opinion a franchise issued by a public agency to be used in a public service should have no value at all in determining the price which should be charged for such service.

Mr. HAGENAH. May I correct what is apparently a misunderstanding? The criticism of the gentleman is wrong. It is true that the sale of electricity for light and power purposes is a public-utility function, but the production of power by means of a water-power plant is not necessarily a public-utility business. If it were, then most of our cotton mills and woolen mills and many manufacturing plants would come under the regulation of public-utility commissions. The operation of a water power is not necessarily a public-utility business any more than the operation of a coal mine is a public-utility business because coal is in some cases used in generating electricity.

It is only the final lighting and power service sold under a franchise which is capable of regulation. The argument made falls down because the particular water power owned by a public utility can be disposed of by that utility just as a public utility owning a coal mine as an investment may dispose of it to a private enterprise. The public may only regulate the public-utility service; it can not regulate the cost of labor and material which enter into the cost of such service.

Again, when I say that the public-utility value determined in this paper is not predicated upon the right of ownership, I am not referring to a franchise. I mean that under the law a utility which owns the land along a stream on which its water power is based does not necessarily own the physical water; it can not take it from the stream and consume it or divert it, but must restore it to the original stream for the use of other landowners below. It does, however, own the right to convert the power or the potential energy of this water at an elevation into electrical energy and may sell or use the product; but only when sold under a public franchise will the power become subject to public regulation, and then only the final product and not the elements of cost which enter into that product. The

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public regulates the rate to be charged for electricity, not the cost of coal, the cost of land, or the cost of water power. These are elements not subject to public regulation. If they were subject to public regulation under the assumption made, what would prevent this particular utility from selling its water powers to the pulp mills which are offering a price greater per horsepower than what is mentioned in this paper? If the public-utility company sells the water power to the pulp mills and then produces its energy by steam power, must not the regulating authority recognize this higher cost and prescribe a rate based on it?

Answering your question further, I hoped my paper made it plain that in computing the cost of the company's service no use was made of the company's rate schedule. I have used only the direct operating expenses, depreciation, and an 8 per cent return on the appraised value of the physical property devoted exclusively to power-production purposes.

Mr. MERRILL. I misunderstood your statement about not owning the water power. The condition of which you speak is the one that formerly obtained in Oregon.

Mr. HAGENAH. The company has the right to use the water.

Mr. MERRILL. They have such right under an old law. Such rights are not subject to sale under existing law in Oregon, nor can they be sold under the law of California.

Mr. HAGENAH. These water rights, as I recall, were secured under the previous law and are now devoted by choice of this company to public-utility uses. The question is one that interests all of the cities west of the Missouri River. Usually the companies which are devoting their water powers to public-utility interests receive a recognition of the values of those powers if there is in fact such a value. If such value were not recognized, I imagine they would look for it elsewhere, and higher rates might result for the public-utility service. I grant that the application of this method will show that many water powers have no value, and I honestly believe that many of them have no value beyond the cost of the physical structure required in the development. Money has been induced to go into many such developments on the belief that all water powers are valuable; but they are not all valuable by any means. One water power may be worth a great deal, and another power on the same stream, 5 miles away, may be worth practically nothing. If the water power has in fact no value over and above the physical investment I would object to a value being allowed for it. If, however, it has a proven value we should recognize it.

Mr. HEROY. Mr. Hagenah has confused to a certain extent the difference between coal and water as a source of power. In the case

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of water power I think from the earliest times it has essentially been considered as public property, and the use of water in most of the Western States' constitutions is declared to be a public use. The Western States have from time to time permitted under their own laws the appropriation of that water; that is, given rights to private individuals to use that water. That right is essentially a franchise. It is unnecessary to secure a franchise in this country to use coal. It is necessary in most instances to secure a franchise to use water. The public therefore in giving the franchise to use water retained to that extent the power to control the use of that water. I think there is the fundamental distinction between the generation of power from water and from steam.

Mr. WELLS. I should like to ask the author of the paper one or two questions to clear up my own understanding of the things stated when the paper was read. Where did you get the $8,000,000 cost item for the Portland public utility?

Mr. HAGENAH. That was determined by an appraisal of the physical property of the utility reduced by the amount of the existing depreciation.

Mr. WELLS. Including both the structures and the land, I take it?

Mr. HAGENAH. Yes; but only the physical property.

Mr. WELLS. How was the price of the land arrived at?

Mr. HAGENAH. The market value of the land was determined along the lines of the ruling of the United States Supreme Court in the Minnesota rate case.

Mr. WELLS. That land included power sites, I take it?

Mr. HAGENAH. No; merely the value of agricultural land, based on the prices which had been paid for ranch lands along the river. The land values exclude and therefore do not reflect the water-power values.

Mr. WELLS. I am glad to have that explanation, because that matter was the one point about which I had most doubt as to the economic soundness of this paper. The value of water power, of course, like the value of everything else, depends upon the supply and demand. We have all the phenomena of a market, although they are somewhat obscure, whether it is a competitive market or a monopolistic market; still, the value depends upon supply and demand, as it seems to me. Now, when we come to the side of law, the paper seems to assume a property right in this intangible element which it is trying to value. That is the basis of the paper, if I understand it, and that right in part is a water right.

Now, I do not think there is any economic distinction or any profound legal distinction between a water right in the East, where riparian ownership prevails, and a water right in the West, where it

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is appropriated in accordance with the State law. The right to use the water as it flows is the thing that the power company has in either case. It gets it by virtue of riparian ownership in the East, and in the West it gets it by appropriation, but in either case it is the same thing. It is the right to use that water as it flows, and not the right to destroy the corpus of the water. That is inherent in the water itself.

Now, Mr. Heroy has pointed out that the Western States—a good many of them—have declared the public character of this right to use water. I would not venture to say whether or not as matter of law the assumption of the paper is correct—to wit, that this is property, private property, in the hands of this public-utility corporation, upon which they have a right to earn a return. That is a pretty complicated question. There is certainly something to be said on Mr. Heroy's side of it. But I call attention to this fact, that any such public-utility corporation, wherever situated, must at some time come to the public and get from the public something it has not already in order to do its business. If the corporation has the full water right by virtue of general laws, as the paper assumes, still it has to come to the public to get something more in order to realize upon that theoretical paper water right; it has to come to get its corporate franchise. Without that corporate franchise the water-right value would have been negligible in this case. Therefore, at the time when the corporation comes to the public and asks them, "Please give me something more," that is the time for the public to consider what it will give and on what terms it will give it; and, so far as the water itself, the water right, or the land is concerned, when the company tried to acquire a title to either water rights or land, then the public should bear in mind that if the right is given without compensation we will have the result set forth in this paper—to wit, that there are $4,000,000 worth of property which before that decision was made was public property and after that decision was made has become private property, for which the public must pay forever a rental to the people to whom they gave it.

With respect to the alternative that such a utility company may sell its power to industrial plants, such as pulp mills or cotton mills, and thereby escape public regulation, they could do that if their title is absolute, provided there was a sufficient number of pulp mills or other mills to buy it. I should be surprised if the fact is that in this district there are pulp mills enough to take the entire output from this plant at prices which would compensate this utility at a better rate than they are now receiving.

Mr. HAGENAH. Answering your last statement, there are some pulp mills in the Portland and Willamette Valley districts at pres-

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of water power [illegible] from the earliest time [illegible] considered as public property, and the [illegible] Western States constitutions [illegible] declared [illegible] Western States have from time to time permitted the appropriation of that water that [illegible] individuals to use that water. That right [illegible] is unnecessary to secure a franchise [illegible] is necessary in most instances to secure [illegible] The public therefore in giving the franchise [illegible] must extend the power to control the use of [illegible] is the fundamental distinction between the [illegible] water and from steam.

Mr. Weeks. I should like to ask the [illegible] two questions to clear up my own [illegible] points when the paper was read. Where [illegible] was from for the Portland public utility [illegible]

Mr. Hanscom. That was determined [illegible] and property of the utility reduced [illegible] depreciation.

Mr. Weeks. Including both the [illegible]

Mr. Hanscom. Yes; but only the [illegible]

Mr. Weeks. How was the price [illegible]

Mr. Hanscom. The market va[illegible] the basis of the ruling of the [illegible] Commission rate case.

Mr. Weeks. That land is [illegible]

Mr. Hanscom. Yes; were [illegible] on the power which land [illegible] The land values exclude [illegible] value.

Mr. Weeks. I am glad to [illegible] ter was the one point abo[illegible] simple soundness of this [illegible] like the value of everyth[illegible] mand. We have all th[illegible] suppose [illegible]

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community, and develop that land factor for which
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st manner its broadest obligation toward the public.

MAN. If there is no further discussion I wish to an-
the presentation of Mr. Leighton's paper will be post-
to-morrow morning.

on the meeting adjourned.

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ent which would double their capacity if they could acquire the power now devoted to public-utility uses, and there is enough timber there to supply other pulp mills if it were known that additional water power was available.

Answering another question, I might say that the Railroad Commission of California has within the last year and a half decided that an irrigation company which was operating as a public utility had a right to earn, not only on the investment in physical property, but also on its water rights, for the right to apply water for public utility purposes was considered a property right.

Mr. MERRILL. Was not that the Supreme Court rather than the railroad commission?

Mr. HAGENAH. I am not sure; it may have been the Supreme Court. That would be still better authority.

Mr. WELLS. I am familiar with that case in California or was familiar with it. It arose with respect to an irrigation company in California, and the regulation in the case was applied by the board of supervisors, which at that time had the regulating authority in that State. And the Federal Court of Appeals at San Francisco had held in very unlimited terms that the right to use water which the company had acquired could not be considered at all; it must be put in at zero in estimating the reasonableness of its charges and returns. That decision was reversed by the Supreme Court of the United States, but if I remember correctly the Supreme Court of the United States did not intimate that they could put it in at infinity. They had paid something actually for those rights and the Supreme Court held that those payments could not be ignored as a matter of law. I do not think it follows, at least they have not yet decided, that that was absolutely private property for which they could charge all they could get, all that the traffic would bear, as they could for a piece of land that they had acquired in some other way.

Mr. ASHLEY. I would like to ask what effect on your valuation of a water power will be brought about by the recent legislation which has affected the lumber business in the Northwest and has cut down the supply of slabboard. Would that increase the value of your water power?

Mr. HAGENAH. That would introduce two tendencies. The cheapest fuel now used is the sawmill refuse, and if that were removed the first result would be to increase the value of the water powers. If, however, the manufacturing companies now located near the sawmills would be deprived of their cheap fuel, and would use electric power in driving their mills, as those at a greater distance are doing, there would be a generally improved operating condition, and

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the output would be greatly increased, so that I am inclined to think it would in time offset any increased value that might at first result from the removal of the slab wood as a fuel. I believe that as these districts are more and more developed and the load factor becomes as nearly perfect as possible, this element of value over and above the value of the physical property will diminish and tend to disappear and then the public will get the full benefit of its natural resources.

Mr. MERRILL. Would not the improvement of the load factor reduce the cost to the public utility and make the difference between its cost and the weighted average greater than it was before, and therefore make the water rights more valuable?

Mr. HAGENAH. No.

Mr. MERRILL. Of course, if the entire market were taken over by the utility and they served everybody, then the water power value would be nil.

Mr. HAGENAH. Probably. I think that is what we are working toward in this country. The soundness of my argument is proven by the development in this district within the last few years. Some of the former high cost power plants are now being supplanted by the public utility, and additional electrification of railroads is under way. I believe when the public utilities are able to supply all the demands in their community, and develop that land factor for which the industry strives, they will be satisfied with a reasonable return on the fair value of their property. Not until then can the utility fulfill in the best manner its broadest obligation toward the public.

The CHAIRMAN. If there is no further discussion I wish to announce that the presentation of Mr. Leighton's paper will be postponed until to-morrow morning.

Thereupon the meeting adjourned.

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## JOINT SESSION OF SUBSECTIONS 5 AND 6 OF SECTION III.

RALEIGH HOTEL,
*Tuesday morning, January 4, 1916.*

Chairman, DAVID FAIRCHILD.

The session was called to order at 9.30 o'clock by the chairman.

The CHAIRMAN. The first paper of the session will be by Mr. O. F. Cook, of the Bureau of Plant Industry, on "Possibilities of intensive agriculture in Tropical America."

Mr. COOK. In this paper I have tried to express a point of view, rather than to give details of agricultural facts. One great difficulty, apart from all questions of climate, hygiene, and transportation is that the colonists of the Tropics, mostly from Europe, have come to America because they think they can get more land. The first impulse has been to acquire large tracts of land, with the result that each European settler is in possession of a large tract of unimproved land, out of reach of his neighbors and of the facilities of civilization.

Improvements of the last two or three decades are of a nature such as completely to revolutionize the Tropics. Modern sanitation, the automobile, electric power, and all other improved means of communication are changing the possibilities of agricultural developments in the Tropics.

One may get an idea of this change on a visit to the tropical parts of the United States. I think we have here an analogy of what may be expected in the Tropics. It is forecast in those regions, where these modern facilities have been introduced; and that means, of course, a revolution that we must foresee in the development of tropical agriculture.

The native population lives by cutting and clearing, moving on from clearing to clearing. The tropical idea is a special thing that has been limited to special conditions and to relatively few localities. For instance, coffee and most of the other products of the American Tropics have been raised more or less on the native system; that is, the coffee plantation has been put in a given place where the soil seemed to be fertile and maintained for a series of years. Finally when the soil runs out the planter has been accustomed to start



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another plantation on another piece of land and abandon the old coffee plantation.

Any complete installation of modern facilities, therefore, must be put on a better basis. There must be centralized districts where people are to live permanently and maintain a permanent community. We must have more extensive use of tree crops, and instead of exhausting the soil and allowing grass to come in and permitting the land to be abandoned, we must establish permanent forest conditions; that is, a tree culture in the Tropics which will not only represent permanent culture, but will actually increase the fertility of the soil.

## POSSIBILITIES OF INTENSIVE AGRICULTURE IN TROPICAL AMERICA.

By O. F. COOK,

*Bureau of Plant Industry, United States Department of Agriculture.*

Tropical agriculture is entering upon a new period of development. A rapid transformation is going forward, as a result of the control of tropical diseases by sanitation, and the introduction of electric power, automobiles, and telephones. Civilization is becoming more and more dependent upon the Tropics. Recent decades have witnessed rapidly increasing demands, not only for spices, drugs, rubber, fibers, and woods, but also for food products, notably bananas and other fruits, coffee, cacao, and many kinds of vegetable oils.

The new development of tropical agriculture must be on an intensive basis if there is to be a full utilization of the modern agencies of progress. Of the past it may be said that tropical agriculture, and especially the agriculture of tropical America, has been on an extensive basis. Instead of forming compact agricultural communities, settlers have been scattered widely upon large tracts of land, without adequate means of communication or other facilities of progress. In agriculture the result has been the continued following of native methods that are rapidly destructive of the fertility of the soil.

### CONDITIONS OF TROPICAL PROGRESS.

The slow development of tropical agriculture, in comparison with the agriculture of temperate regions, is usually ascribed to unfavorable climatic conditions, but the reason must appear inadequate to all who have wide familiarity with tropical countries. There are many insalubrious places in the Tropics and many outside, but the Tropics also contain some of the fairest regions of the globe, very well suited to human existence and naturally favorable to the development of civilization. It is admitted that man is by nature a tropical animal, and that the early stages of progress toward civilization were passed in the Tropics. Agriculture must have begun in the Tropics, for the tropical crop plants appear to have been domesticated longer than the temperate species. Even among the plants cultivated in temperate regions, some of the most important appear to have originated in the Tropics.

The question is whether civilization in the higher or more complex forms that have developed in temperate regions can be carried back and reestablished in

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the Tropics. Those who view the question wholly from the outside, from what might be called a European or northern standpoint, often give a negative answer; but certainly no such hopeless view has been entertained by those who are most familiar with the tropical regions, otherwise tropical America would never have been settled by colonists from Europe.

Ideas of tropical possibilities are being revolutionized even inside the United States. The automobile has already brought about a radical alteration of agritural life and prospects in southern districts of Florida and California. Southern Florida is being developed along tropical lines, as the visitor must realize when he rides along the coast at Miami through thousands of magnificent cocoanut palms and sees avocadoes, mangoes, and other tropical crops planted on a commercial scale. This region remained relatively inaccessible to agriculture as long as dependence had to be placed upon horses and mules, but with power vehicles substituted for beasts of burden, the most tropical districts have developed in recent years even more rapidly than other parts of the State.

Many tropical countries have far better natural resources than southern Florida, and many people who live in tropical countries believe strongly in the possibility of development. They believe that the natural conditions are favorable for a higher development of agriculture and other arts of civilization instead of precluding such development. Obstacles and problems there are, of course, and of many kinds, differing endlessly with local conditions, which can not be considered here. Tropical problems form the subjects of hundreds of books and magazine articles that are published every year. But there is one general factor or condition that enters into many of the special problems and calls for a change of policy or redirecting of efforts in tropical development.

### COLONIZATION ON AN EXTENSIVE BASIS.

The methods of colonizing and conducting farming operations in tropical countries have not been well adapted to the needs of progress under tropical conditions. In general the colonization of tropical countries has gone forward on the same basis as in the temperate regions. The chief incentive of the pioneers or first generation of settlers has been the European instinct of land hunger—the desire of the individual to possess and control as large a tract as possible. In other words, the feudal ideal has remained dominant in the colonization of America, even among colonists who came to America to escape feudalism in Europe.

The effect of large individual holdings in new regions has been to scatter a few European settlers very thinly over large tracts of country, out of reach of any effective contacts with civilization and unable to do more than exploit the natural resources of the land, instead of undertaking a constructive development of its agricultural possibilities. Many unfortunate results can be traced to this system in temperate regions, but in the Tropics it has often been fatal to progress. All the difficulties of producing and marketing tropical crops have been enormously increased. Yet the defects of the extensive system have not been appreciated, because they represent a general condition. Regions might be mentioned as exceptions, like the district about San José in Costa Rica, but most of these are of limited extent and lie in elevated regions with temperate climates, so that they hardly represent the possibilities of tropical progress.

In general it may be said that the attempts that have been made to carry the feudal system into the Tropics have failed in the past, and like failure is to be expected for the future. The native populations, from which the laboring force must be recruited, are either organically inferior or have remained at such primitive stages of development that contacts with them are injurious and

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finally destructive to the European colonist or his family. The workers outnumber the planters, and the majority influence tends eventually to prevail. For a generation or two the habits and traditions of efficiency brought in from Europe may be kept, or in many families for longer periods, but of the general tendency there can be no doubt. It is as natural and persistent as the force of gravitation itself.

### FOLLOWING NATIVE METHODS OF AGRICULTURE.

Complete dependence on native labor tends to limit agriculture to the native methods, which are rapidly destructive of the fertility of the soil. The idea that tropical lands have inexhaustible fertility seldom has little justification in fact. Usually there is a rapid loss of fertility when tropical soils are handled by the methods that are generally employed. Agriculture is maintained largely by keeping the crops on new land. Outside of the plateau regions the native agriculture of tropical America is essentially nomadic, being based on the cultivation of maize and other crops that can be changed frequently. The custom is to cut down and burn over a new piece of land every year, in order to plant cornfields. After a few crops have been raised, often only a single crop, the land is abandoned to the growth of the native vegetation.

The same nomadic tendency has been apparent in many tropical undertakings. It is all too common to find large enterprises established at great expense, prosecuted for a few years, and then allowed to fall into decay. The idea that tropical undertakings are essentially temporary is found in many countries. It is usual to think of plantations, even of long-lived crops like bananas, coffee, cacao, and coca, as needing renewal after intervals of a few years. In many districts such plantations are not expected to last for more than 10 or 15 years, and are then abandoned for new land until all of the available land is exhausted. But it is known that these trees have a possible duration of 30, 40, or 50 years in situations that afford continuously favorable conditions.

### PERMANENT OCCUPATION OF THE LAND.

Permanent occupation and full development of the possibilities of any tropical region must have as its basis an intensive system of agriculture, able to guard and maintain the fertility of the soil. Few tropical soils, if any, have the kind of permanent fertility possessed by many soils in temperate regions. Such soils are found more commonly at higher elevations in tropical countries, but at low elevations only in limited districts of alluvial flood plains. Elsewhere fertility must be maintained and increased by cultural methods, or production declines.

There is a general impression that tropical agriculture can be improved by applying the methods that are used in temperate regions, but such efforts generally fail and sometimes the results are disastrous. Even when the planter has learned that he can not use plows, he is likely to cling to other almost equally harmful habits of hoeing and exposing the soil to weather and erosion.

The great practical problem of tropical agriculture is to learn how to keep the soil covered, instead of exposing it to occupation by weeds or washing away by rains. Not necessarily the same crop, but at least some succession or rotation of crops must be grown on the same land, continuously, for long periods of time. From the standpoint of the customs and beliefs generally prevalent in tropical America this would not be considered possible, but there is reason to believe that more intensive methods would render agriculture permanent under many conditions where it is now essentially nomadic.

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### THE STRUGGLE WITH WEEDS.

One very serious reason why the agricultural occupation of the Tropics must be on an intensive basis lies in the continuous and rapid growth of weeds that greatly increase the labor and expense of clearing and cultivating the land. The tropical farmer can not stop for winter. There is no ally in the form of frost to keep the weeds from growing, and the land is practically lost if neglected for a few months. Once taken by weeds the land must be allowed to grow up to bushes so that it can be cleared again by fire, or at much greater expense by hand labor, which can be used only when it is very cheap. The alternative is to use the land constantly and keep it covered, as far as possible, with useful plants instead of with useless weeds injurious to crops and costly to remove.

### PROMISING TROPICAL TREE CROPS.

The Tropics afford an enormous number of valuable tree crops, adapted to the widest possible range of natural conditions and uses. Forests of useful trees will be a feature of the intensive system, to replace the worthless weeds and bushes that now cover large areas of waste lands in many tropical countries, as a result of the desultory methods of tropical exploitation followed in the past. Three classes of tree crops of great potential importance may be mentioned as illustrations:

*Oil-producing palms.*—There is a rapidly increasing demand for vegetable oils as substitutes for meat and dairy products, and for many industrial purposes. Two important sources of vegetable oils are the coconut and the African oil palm, *Elaeis guineensis*. The coconut is widely known and its culture is rapidly extending, but the African oil palm is still confined to a single region. The fruits of the oil palm have a fleshy, oil-producing pulp as well as an oily kernel, so that two kinds of oil are produced. But the fresh pulp also serves directly as a food, has an excellent flavor, and is highly nutritious. Thus the oil palm is worthy of consideration as a food crop in any tropical region, quite apart from the commercial possibilities. Nevertheless, the practical utilization of such a tree outside its native country depends upon a well-supported policy of intensive development, for palms and other tree crops take time to grow and must be planted in large numbers if products of commercial importance are to be obtained.

*The avocado as a food crop.*—The avocado is widely known, but its possibilities as a food crop are seldom appreciated and nowhere fully realized. The varieties are numerous and differ widely in season of maturity as well as in other respects, so that production could be carried through several months and probably through the entire year in many tropical and subtropical regions. The fruits are savory, highly nutritious, and easily digestible. The trees are large, long-lived, and very productive. Obviously the avocado might become a very important element of the food supply of progressive communities organized to take full advantage of the natural resources of production.

*Cacao culture undeveloped.*—Cacao is recognized as an important tree crop, but its possibilities are still very far from being realized. Many problems of culture and protection against disease remain to be solved, but these are not the only directions from which progress may be expected. The consumption of cacao in temperate regions is still very far below its true possibilities, owing to the fact that the methods of preparation and use are still very imperfect. The result is that cacao is used mostly as a flavoring material, very little as a food. Indeed, it is customary to extract and discard from manufactured

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forms of cacao the oily materials that represent the most nutritious elements. The manufacturing processes yield a residue often indigestible and unattractive in taste, and altogether inferior to the beverages that the natives of Central America know how to prepare directly from the dried seeds. With the problems of production and utilization once adequately solved, the growing of cacao might become the chief branch of tropical agriculture. Linnaeus gave cacao the name Theobroma, or food of the gods. What is now needed is to make it fully available as food for men.

CONCLUSIONS.

Agriculture in the Tropics is undergoing rapid changes by reason of the application of modern improvements in machinery, electric transmission of water power, transportation, communication, and hygiene. In connection with this movement more intensive systems of tropical agriculture are needed—systems that are able to support larger populations for longer periods of time, and thus able to justify the installation of the modern facilities of production, comfort, and protection against disease. In developing these more intensive systems of tropical agriculture much more is to be expected from a greater utilization of tree crops than from attempting to carry agricultural methods of temperate regions into the Tropics.

The CHAIRMAN. Is there any discussion of Mr. Cook's paper?

Mr. MAYO. It seems to me that in the discussion of a subject of this kind we must forget, at least to a considerable extent, our strictly American view of Latin-American conditions. We must remember that much of Latin America is very primitive; that the land holdings there are usually not very large areas; that the wealth is in the hands of comparatively a few individuals; and that the natives as a rule have had very little opportunity for development other than that which they have wrought out by themselves.

I remember, when I first went into the Tropics, I went to see a native who was buying a few cows from an American. After he had picked out his cows I asked him through an interpreter what points he based his judgment on in making his selection. He said, "The horns and the hair and the tail"; and that was an entirely different method from our American point of judgment in the selection of cattle. I asked him why he based his opinion on the horns. His answer was that he sold most of his bulls for work cattle, and that he picked cows that had big, strong horns because they yoked them entirely by the horns.

I asked about the hair. He said if you got these American cattle with long coats of hair, that the ticks would eat them up. Then I asked him about the tail, and he said that when a cow had a long tail it walked faster than it did with a short, stubby tail. I was not so sure of that, on a scientific basis.

But the point is that they look at things from an entirely different point of view. They have, from experience, adapted themselves to

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CONCLUSIONS.

Agriculture in the Tropics is undergoing rapid changes by reason of the application of modern improvements in machinery, electric transmission of water power, transportation, communication, and hygiene. In connection with this movement more intensive systems of tropical agriculture are replacing systems that are able to support larger populations per square mile and thus able to justify the installation of the modern facilities for production, comfort, and protection against disease. In developing these intensive systems of tropical agriculture much more attention will be given to a greater utilization of tree crops than from attempting to transfer the methods of temperate regions into the Tropics.

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conditions that we do not always appreciate. It seems to me that in the beginning of an intensive agriculture we must have comparatively small landholdings in this region. In my judgment what is needed more than anything else are small farmers who shall own the land they till.

Then, again, there is the question of education, which must be the basis of all progress, there or elsewhere, and which is one of the things that is woefully deficient at the present time. Probably in Costa Rica, one of the most progressive countries of central and northern South America, that is not so apparent as in most other regions; but, after all, it would be exceedingly difficult, in my judgment, to take our modern North American agricultural ideas and transplant them without an immense amount of development, both economical and social, of the peoples there.

Mr. COOK. My argument was to the effect that it is not only inadvisable to apply these Temperate Zone methods in the tropics, but that it is often impossible to do so; that our methods are not only out of reach of the native population, but often they are entirely impracticable. We only show our failure to appreciate the requirements of the tropical conditions by generally recommending these methods. They are often tried with disastrous results, by men who come in and take it for granted that the local population is entirely wrong in not using the European or North American systems. If the settler insists on plowing he may be destroying his plantation. If he is located on a slope and succeeds in getting it plowed, which he often fails to do, the next rain washes it down the mountain side. There are places where plowing is feasible and desirable, but a great deal of the work that is now done on tropical plantations in the way of clearing the land and in the way of cultivating the crops, are not only primitive, but destructive.

I remember talking with a coffee planter in Guatemala who was beginning to appreciate some of the advantages of keeping the grass out by permitting the growth of other forms of vegetation. I said to him, "You consider that these particular kinds of weeds in your plantation do not injure your coffee at all." The coffee was in fine condition and had an excellent "cover crop" of spontaneous vegetation. He said, "No; that is good for the coffee." And then I said, "Why do you remove this protection and expose your soils to be washed off by the rains? Why do you not leave it there, just to try the experiment?" He said, "If my neighbors came by here they would think I was neglecting my place."

The CHAIRMAN. I do not think anyone could go to southern Florida and see what they are doing down there—it is entirely different from what you see in California—without realizing that in the southern

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border of our country the Americans are working out some of these methods of tropical agriculture. Mr. Cook mentioned the aguacate or palto. He did not mention one fact in regard to it that is not known by a great many people; that is, the unusual amount of oil which it contains—something which we will hear more about in the future than we have so far. Analyses of the Guatemala type of aguacate showed as high as 24, 25, and even 29 per cent of fat. This amount is something quite unheard of in any of the ordinary fruits. It puts the aguacate in the class with the olive. When you think of a fruit containing 29 per cent of fat you get some idea of the kind of problems and possibilities we are opening up in this tropical agriculture.

Is there any further discussion on this question? If not, we will pass to Mr. Collins's paper, which was to have been read in the afternoon session. However, as Dr. Webber was not able to be here, Mr. Collins has kindly consented to read his paper on "Tropical varieties of maize" at this time.

## TROPICAL VARIETIES OF MAIZE.

By G. N. COLLINS,

*Bureau of Plant Industry, United States Department of Agriculture.*

Maize, or Indian Corn, was the most widely distributed and by far the most important food plant cultivated by the natives of America at the time of the discovery. It is still the most important American crop plant, and while much more productive strains have been developed than any grown by the aborigines, the range of the species on the American Continent has not been greatly extended.

To be able to grow under the widely different conditions that are found in the region from central New England to Argentina and Chile, there must be a great diversity of types. How great this diversity is and how inadequately it has been utilized in developing strains adapted to the needs of the different agricultural communities it is the object of the present paper to discuss.

The Department of Agriculture here at Washington has for a number of years been collecting the types of maize from the different parts of the world. These varieties have been grown and their characteristics studied with a view to determining which of the characters they possess may be utilized in developing varieties better adapted to the different parts of the country.

It has not been possible to make an adequate survey of the existing varieties of any country and there are many regions of which we have practically no knowledge of the kinds of maize. Agricultural expeditions that are sent out are usually compelled to pass more or less hurriedly through the countries they visit and the explorers in charge are always charged with collecting a great variety of plants and data, so that little more can be done than to snatch what is exhibited in the markets or what is found growing immediately along their routes. Such collections have been supplemented by seed secured from consuls and correspondents. While many valuable introductions have been secured in this way,



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ignorance of the normal behavior of the varieties and of the cultural and climatic conditions under which they have been grown often stand in the way of making the most of the peculiar qualities they may possess.

As a result of this rather haphazard manner of securing material our collections are very uneven. In some few places the series of varieties is comparatively complete, but there are whole countries not represented in our collection by a single maize variety. Enough has come to light, however, to show that, especially in the countries of tropical America, we have an immense storehouse of valuable material that awaits the utilization of the breeder.

We have come to believe that the search must be made for characteristics rather than for varieties ready made, as it were. It seldom happens that a variety from one locality will be found adapted to any other locality, but often the most unpromising and insignificant variety, grown perhaps by some backward tribe of natives, will possess some peculiarity or adaptation that needs only to be combined with the desirable qualities of other varieties to become of great value.

Instead, therefore, of attempting to present any complete description of varieties of corn, I shall enumerate a few of the more striking adaptations that have thus far been discovered, beginning with the varieties grown by the Indians of the western United States.

## HOPI MAIZE.

The Hopi, Navajo, and Zuni Indians are still growing a type of maize that seems to have spread but little outside the region inhabited by these tribes. The prevailing type of seed is soft or amylaceous, the plants tiller abundantly, they are early maturing, and make comparatively rapid growth at low temperatures. Their exact water requirement has not been determined, but it would appear that they are comparatively economical in the use of water. These characters, while valuable, are all quantitative. This type of maize does, however, possess one unique feature. All other types of maize thus far studied produce three or more roots from the seed. These roots support the young plant until the permanent roots that develop from the nodes have been formed. In the type under discussion there is but one root developed from the seed. The economy of this arrangement seems to be that the single root is able to penetrate to a greater depth than is possible when the reserve material of the seed is divided among three or more roots.

In combination with this character there is also the possibility of a much greater development of the mesocotyl than in other types. The mesocotyl is a specialized organ found in the seedlings of maize and some other grasses. It may be described as the part of the main axis that connects the seed with the first leaf of the seedling. So long as the germinating seed remains in the dark, the mesocotyl elongates, stopping only when the tip of the seedling reaches the surface of the ground or the limit of elongation is reached. In planting their maize the Hopi Indians dig into the sandy soil until they reach moist earth, usually found at a depth of from 6 to 18 inches. The seed is deposited in these holes in contact with the moist soil. Although these holes may be left only partly filled, the drifting sand soon fills them, and to reach the surface the young plants must penetrate from 6 inches to a foot of soil.

Experiments have shown that commercial varieties of maize planted under these conditions will not reach the surface. The maximum development of the mesocotyl in commercial varieties is from 8 to 10 centimeters. After this elongation is reached the leaves attempt to expand beneath the ground and as they unfold they are not sufficiently rigid to force their way through the soil.

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It was found that the mesocotyl of Hopi maize was capable of elongating to a length of 36 centimeters or over three times the length attainable in other varieties. At the same time the single strong seminal root is following the retreating moisture and keeping the young plants alive until the summer rains wet the soil above and allow the development of lateral roots. A long mesocotyl thus divides the work of reaching moisture with the single seminal root and the combination makes possible the establishing of young plants in soils where the nearest available moisture is a foot or more below the surface of the ground.

These peculiarities make this type of maize beautifully adapted to the conditions that obtain on the wind-swept plateaus of northern New Mexico and Arizona where the variety is grown. In this region there is a winter rainfall, but by the time the weather is sufficiently warm to warrant the planting of maize, the surface soil is thoroughly dry. Summer rains may be expected in June or July, but if planting were delayed until the rains came there would not be time enough for the crop to mature before the frosts came in September.

These adaptations should find an application wherever maize is planted during a dry season, and the young plants are forced to depend on moisture stored in soil. At San Diego, Cal., the past season plants of this type matured normally without a drop of rain during the growing season.

That adaptations of so great economic importance should exist inside our own country and remain unnoticed is a striking indication of how inadequately the possibilities of maize development have been investigated.

### ZEA HIRTA.

Another set of interesting adaptations have been found in a type of maize from the table-lands of Mexico. This type was early recognized as a distinct form. In 1829 it was given specific rank by Bonafous under the name *Zea hirta*.

The most striking characteristic of this type is a peculiar development of hairs on the leaf sheaths and also to some extent on the blades. For this most conspicuous peculiarity we have not as yet been able to discover any adaptive significance.

On the tablelands of Mexico where this maize is grown the rainfall is very light. In the parts of the United States with a similar rainfall maize production is not considered a possibility. We were, therefore, extremely optimistic regarding the utilization of this type of maize. Our early experiments were very disappointing. In the semiarid regions of the West this variety was a complete failure. Instead of being drought resistant the plants appeared to suffer from drought more than the ordinary varieties from the corn belt. Without the viewpoint that each distinct type of maize possesses adaptive characters this variety would have been discarded as worthless. As soon, however, as the variety was scrutinized with respect to the separate characteristics instead of trying to utilize it as it was, imporant adaptations came to light. The first peculiarity noticed was the nature of the root distribution. In this type of maize the roots seem to have lost the ability to penetrate the soil. In a full-grown plant the roots are all horizontal and confined to the upper 6 inches of soil. There is so little direct attachment to the soil that the whole plant can be lifted up and down by the hand. The plants are on rather than in the ground. This peculiar root distribution helps to explain why the plants are able to grow in Mexico with so little rainfall and why they fail in the western part of our country. In the part of Mexico from which this variety was secured the little rain that falls comes during the growing season in the form of light, misty showers. The rainfall is at no time sufficient to penetrate

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to any extent and an extensive superficial root system is best adapted to utilize the moisture.

This particular adaptation we are unable to utilize in this country, for in the drier parts of the United States the rainfall comes largely in the winter instead of during the growing season, and growing plants must draw their water from that stored in the ground some distance below the surface. There are, however, many regions in tropical America where this adaptation should be of value. Through the work of Briggs and Shantz, of the Department of Agriculture, it has been shown also that *Zea hirta* is the most economical of water of any of the varieties of maize yet studied.

Still another adaptation possessed by this type of maize was observed during the past season in the course of experiments conducted near San Diego, Cal. It there developed that this type of maize made satisfactory growth at lower temperatures than any of the other types with which we were experimenting. This does not mean frost resistance, nor does it mean that this type is suited to extend maize growing farther north. It means rather that this type possesses one of the characteristics necessary to a variety of maize for regions where the temperatures are uniformly too low for the ordinary varieties. Temperatures below the optimum for maize are the rule over a large part of the elevated regions of the Tropics. In the development of varieties for cool climates, this type of maize promises to be of great value. Our experience with *Zea hirta* shows also the folly of looking for drought resistance as such. To make progress, we must distinguish between the different kinds of drought resistance and search for the particular adaptation needed.

Nearly every region from which we have received varieties has contributed adaptations that promise to be of value. From Bolivia has come a type possessing to a marked degree the quality of remaining green for a long time after maturity. Mexico has given us one variety with the largest ears and another with the ability to withstand extremely high temperatures. Peru contributes the largest seeds. From China comes a variety with a new type of endosperm and the ability to withstand hot dry winds at the time of flowering. Our best protected ears come from Guatemala.

Enough has now been said to indicate what is meant by adaptation and how the varieties must be studied to realize and appreciate the adaptations. Only a beginning has been made. When it is realized that no two regions present exactly the same environment and that maize, though a very ancient crop, is very plastic and has molded itself to the conditions under which it has been grown, some idea may be gained of the multitude of adaptations that await discovery.

### *Recombination of characters.*

A word must now be said regarding the recombination of these adaptations into new varieties suited to new conditions or representing an improvement over varieties already existing.

Regarding the recombination of characters, our knowledge is still very imperfect, but here also a beginning has been made and results sufficient to serve as demonstrations have been secured. An example may be taken that is particularly applicable to tropical America.

When a visitor from the North visits tropical America and finds maize a staple crop and often growing luxuriantly, he is naturally struck by the absence of table or sweet varieties so generally grown in this country. I have made inquiry in a number of instances and almost invariably have been told that sweet varieties have been introduced, but that they did not do well, and that

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their growth was given up on that account. If it were possible to combine the palatability of the sweet varieties with the luxuriant growth and freedom from insect attack of the native varieties, a valuable addition might be made to the rather meager list of really delicious vegetables available in many parts of the Tropics. We are to some extent confronted with the same problem in our own Southern States where the ravages of the corn worm practically precludes the growing of commercial varieties of sweet corn.

In the breeding of commercial varieties of sweet corn, one of the most important considerations has been earliness. In breeding for earliness the number of leaves have been reduced. In reducing the number of leaves the number of husks, which are homologous to leaves, have also been reduced with the result that the ears of sweet corn are poorly protected. This was of little or no importance north of the region infested by the corn worm, but it is this that renders the commercial sweet varieties unsuited to southern regions.

In 1912 crosses were made between commercial sweet varieties and southern varieties of field corn having well protected ears. The first generation plants were grown in 1913, and selections were made from those plants with the most perfectly protected ears. From the ears thus obtained, which contained a mixture of sweet and nonsweet seed, we selected the sweet seed for planting in 1914. In that season the plants were very variable, but all the seeds were sweet. Crosses were made between the most promising plants, special attention being again paid to the covering of the ears. The results of the past season demonstrated that we already have a fairly uniform and productive variety of sweet corn. Although grown in a region where the infestation of corn worms is particularly severe the damage to the ears was insignificant, less, in fact, than was the damage done to field varieties in the same region. Thus in three years we have combined the sweet seeds of the table varieties with well protected ears of the larger field varieties. It would appear that there is no valid reason why any region that can grow maize successfully should be without sweet varieties. Whether earliness must necessarily be sacrificed, or whether it is possible to secure earliness and still keep the well-protected ears is an interesting question that must await further investigation.

All characteristics can not be manipulated as easily as the sweet endosperm, which from the alternative nature of its inheritance permits of Mendelian recombination, but our experiments indicate that most of the characters of maize are independent of one another in inheritance and that recombination is only a question of careful selection following hybridization.

## CONCLUSIONS.

The work of discovering new and valuable characteristics is one in which a cooperative arrangement among the different maize-growing countries of America would be especially applicable. Once an adaptation is observed and the discovery announced, it becomes available to all countries.

Of course, an important step to take is the interchange of varieties, but it is of equal importance to have the varieties studied in their native countries by observers familiar with the maize plant and its variations.

I would strongly urge that each of the maize-growing countries of America make a canvass of the maize varieties existing within its boundaries. In the study of these varieties the particular conditions under which they have developed should be kept in mind. Thus, if a variety is found growing in a region of cool nights, high winds, or any other pronounced environmental factor an effort should be made to determine how the variety meets the peculiar condition.

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I venture again to call attention to the necessity of looking for desirable adaptations rather than desirable varieties and to urge that no variety be overlooked simply because it appears insignificant or worthless. If a variety is growing under climatic conditions that are extreme in any particular, it is more than probable that the variety possesses valuable characteristics.

The CHAIRMAN. Is there any discussion of this extremely interesting paper by Mr. Collins?

Mr. COBB. What is the reason, Mr. Collins, that corn is so little grown in the various parts of Europe?

Mr. COLLINS. You mean, I suppose, in the northern parts of Europe. Corn is quite extensively grown in Italy and Spain. I am not sure, but I would venture a guess that it is because of the uniformly low temperature; that is, a lack of high temperature. Our experiments last year showed that corn was very susceptible to variations in sunlight; that is, when we were measuring the growth of a corn plant, if a passing cloud overshadowed the plant it retarded its growth, and with most of our varities the rather low intensity of light in northern Europe would, I suspect, practically preclude them from ever maturing. They grow corn, of course, as a forage plant and doubtless introduced it from America.

Mr. CLUTE. Where is this place in the Tropics where sweet corn is grown successfully?

Mr. COLLINS. This sample of sweet corn was not grown in the Tropics. It was in southern California last year, south of San Diego; and practically the same thing has been done in Cuba. In Cuba they have varieties of sweet corn which I think are as immune to the ravages of insects as the field corn is to worms. The large kerneled Peruvian corns, some choice varieties of which Mr. Cook brought back from Peru, should find a direct utilization in the cool regions of the Pacific coast, but I am skeptical about being able to utilize many of them in the regular corn-growing sections; certainly not without a great deal of breeding.

The CHAIRMAN. How did these Peruvian corns taste?

Mr. COOK. I do not think any of them are sweet corns, but we had no chance to taste them, as we reached Peru after the corn was all ripe and hard.

The CHAIRMAN. Gentlemen, we are fortunate in having with us Dr. B. H. Rawl, Chief of the Dairy Division of the Bureau of Animal Industry, who will now read his paper on "The rôle of the dairy industry in a system of national agricultural development."

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# THE RÔLE OF THE DAIRY INDUSTRY IN A SYSTEM OF NATIONAL AGRICULTURAL DEVELOPMENT.

By B. H. RAWL,

*Chief, Dairy Division, Bureau of Animal Industry, United States Department of Agriculture.*

In considering this subject broadly, the following factors require attention:

1. Will dairying maintain the fertility of the soil?
2. Does dairying employ labor economically?
3. What are the financial requirements of the dairy industry?
4. What relation does this industry bear to the food supply of the Nation?
5. Is dairying profitable, and will it continue to be?

## WILL DAIRYING MAINTAIN THE FERTILITY OF THE SOIL?

Dairying requires a rotation of crops in which legumes must play an important part. Under such a rotation the ground may be cropped constantly, no "off year" being required for the restoration of soil fertility. This makes possible the economical use of land. Furthermore, in dairy farming, a large part of the fertility which is removed from the soil by means of the crops is returned to it in the form of manure, if the latter is properly handled. When it is necessary to plow green crops under to maintain the fertility of the soil, as is done in some systems of farming, it must be realized that the cost of growing such crops must be charged to fertilization. When, however, they are fed to live stock their cost is borne by the live stock, and the resulting manure is returned to the soil at no cost other than that of handling the manure. While a system of live-stock farming, in its relation to soil fertility, is not perfect, it more nearly maintains soil fertility than any other system of agriculture.

The dairy herd which economically consumes relatively large quantities of feed often requires more grain than can be raised on the farm where the herd is kept; it therefore returns to the soil not only the fertilizing elements in the manure resulting from the crops produced on the farm, but also those from the purchased feed as well. Dairying also utilizes to advantage all straw and roughage that are produced on the farm, for that which can not be used as feed is required as bedding for the animals, and in this way it is returned with the manure to the soil.

Dairying makes possible the profitable utilization of large areas of our waste lands by converting them into improved pastures. This is a phase of agriculture which in this country has as yet received but little attention, but which in time must become a real factor in a comprehensive and efficient system of agriculture. In many sections of the United States almost every farm contains some ground that is too steep or too rough for profitable cultivation; in the aggregate this amounts to millions of acres. Such land when put into permanent pasture constantly becomes more fertile and is therefore an ever-increasing asset to live-stock farming.

Dairying is one of our most profitable forms of live-stock farming, and its significance in a system of agriculture which gives due consideration to the maintenance and improvement of the soil can hardly be overemphasized.

## DOES DAIRYING EMPLOY LABOR ECONOMICALLY?

In view of the rapid increase in population that is going on in this country the question of finding profitable and healthful employment for our people is becoming an increasingly significant problem. One of the objections which is often

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raised to dairying is the amount of labor required. Viewed in another light this feature should be regarded as one of its valuable assets, so long as it employs the labor profitably. On account of the labor requirements—the regularity with which the work must be done—many persons are deterred from going into dairying, but when they appreciate and need its advantages they generally become willing to meet the requirements. It is natural for anyone to be unwilling to work every day in the year, and, while dairy work can usually be arranged so that this will not be necessary, yet for those who wish to have a whole season during which there is no work to be done, dairying is decidedly not the thing.

The labor problems of the small and the large dairy farms are distinctly different. The work of the small farm is usually done by the farmer and his family, while that of the large farm is done by hired help. Investigators often conclude that small dairies are operated at an actual loss, and, of course, some of them are; yet, up to the present time in the United States they are producing the bulk of the dairy products. Is this because the small farmer is willing to conduct his business at a loss, or has he some economic advantage? In some cases the investigators find that these small farms, apparently operated at a loss, have been equipped and paid for entirely by means of the dairy. In one instance a careful investigation of a small dairy farm had been made, an account of all labor had been taken, a value had been assigned to it, presumably at the rate for farm labor in that region, and all the facts seemed to warrant the conclusion that the dairy was sustaining an actual loss. When the owner was apprised of this conclusion his answer was: "This is my farm, and it is paid for; this is my house, and these are my buildings, and they are paid for; this is my herd, and it is paid for. I had no money to begin with and have had practically no business but the dairy. Where did I get these things if dairying is unprofitable?

This case represents conditions on a considerable per cent of our small dairy farms. A vital point which is often overlooked in such cases is that a large amount of the labor employed in small dairies is not marketable except through the dairy. Much of such work is done by the farmer's children before and after school, and by the farmer himself at seasons when he is not otherwise engaged. Such labor perhaps does not bring full value, but it is in a sense a by-product of the farm, which the dairy saves, and which otherwise would be wasted. We know that the majority of such dairies are badly managed, and that if their management were improved this labor would produce much better results. But even under ordinary management we know that in many sections of the country the farmers have accomplished with the dairy what they had been unable to accomplish with any other type of agriculture, and to no other factor are such results more properly attributable than to the economical employment of labor or to the utilization of labor which would otherwise have no value. In a large measure this accounts for the fact that the great majority of the dairy products of the United States, now amounting in value to approximately a billion dollars annually, are produced on small farms.

On the other hand, the large commercial dairy employs a type of labor that is marketable, and such a plant must compete with other enterprises for its labor. Here the problem is entirely different. This type of dairy can succeed only under capable management. In order that its labor may be used most economically, the business must be extensive. Then the various operations can be subdivided into units that are economical. This type of plant will gradually become more numerous and may become more profitable, but for the production of the ordinary dairy products it can never replace the small farm.

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### WHAT ARE THE FINANCIAL REQUIREMENTS OF DAIRY FARMING?

The initial investment required by the dairy is comparatively large. The proper handling of the milk requires better buildings than those on the ordinary farm, and of such construction as to permit their being kept in a sanitary condition. Equipment for cooling and storing the milk and for cleaning and sterilizing utensils is necessary, and the cost of dairy cows is considerable. The small farmer usually meets these requirements gradually, increasing his equipment and his herd during a considerable period of years. This is a disadvantage, for it means losing a number of years of full production before the equipment is completed. Dairymen need some kind of long-term loans in order to purchase this equipment and to get prompt and full returns from it. A part of the increased profits thus obtained, if applied annually to the indebtedness, would in a term of years wipe it out.

The current expense of the dairy is easily met—much more easily than that of almost any other agricultural industry. It supplies its products each day, and the returns from them are made at intervals usually not exceeding one month; hence the business is conducted entirely on a cash basis.

### WHAT RELATION DOES DAIRYING BEAR TO THE FOOD SUPPLY OF THE NATION?

The dairy cow takes grass from the waste lands, various kinds of forage from the fields, and by-products from the manufacture of food supplies, and converts them all into an important class of food for mankind. Some grain is usually fed to dairy animals, and the continuation of this practice will depend upon the value of such grain for human food. If grain becomes so high in price that it can not be fed to dairy animals, the value of dairy products will probably be also sufficiently high to make possible their profitable production without the use of grain.

Dairy products are not only nutritious in a high degree, but constitute a large part of our delicacies. The nutritive value of these products is on the whole but little appreciated. Milk, for example, when used by adults is now regarded as a delicacy, whereas, at ordinary prices, and when the nutrients are considered, it is among our cheapest foods. The same is true of cheese, now used largely as a condiment. Good cheese is a substantial food, equal in nutritive value to some classes of meat, and often much cheaper. Our per capita consumption of cheese is only 3.76 pounds per annum. The low consumption of cheese is attributable in part to a lack of appreciation of its food value, but also the fact that some of it is inferior in quality. The average person unconsciously consumes much more high-grade cheese than low grade, and the same is true of other dairy products as well; therefore, by improving the quality of their products dairymen can greatly increase the quantities consumed. In the markets of the United States there is almost constantly an unsupplied demand for butter and cheese of superior quality.

Within the last 35 years the production of butter in the United States has increased from 800,000,000 to about 1,600,000,000 pounds. Practically all this butter is consumed within the bounds of our own country. The supply of market milk and various other dairy products has also been greatly increased, and the most of them are consumed here. In 1881 this country exported about 148,000,000 pounds of cheese, while in recent years (with the exception of the period during which the European war has been in progress) it has exported practically none, but, on the other hand, it is importing about 60,000,000 pounds annually.

There is another phase of this question which is also significant, and that relates to the amount of dairy products consumed on the farm. This amount

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is at present comparatively small—far too small. The farmer often consumes only a small quantity of butter because he has never had good butter, although it can be produced on the farm in abundance if proper methods are used.

There are certain brands of cheese also that can be produced to advantage on the farm, but in fact are almost entirely absent from the farmer's table. Cottage and Neufchâtel are varieties that should be found there in abundance. These are substantial foods and delicacies as well, and can be had on the farm at only a nominal cost, as they need not add greatly to the labor of the farm. Many millions of pounds more of dairy products can be used to good advantage on the farm, and would add to farm life an attractiveness which at present is often lacking.

Even at the present rate of consumption we are hardly keeping up with the demand for dairy products, as is particularly indicated by the cheese situation. An increased consumption on the farm is possible, however, and can be brought about by teaching the farmer the value of dairy products and the proper methods of producing and handling them. Additional consumption would result from the manufacture of a larger quantity of dairy products of superior quality. All these factors seem to warrant the conclusion that the natural increase in the demand for dairy products may be expected together with the development of farm life and with the improvement in the methods of the manufacture and handling of dairy products.

Civilized nations require large quantities of dairy products, and it seems safe to assume that with an intelligent system of agriculture the people of an extensive and resourceful country will never consent to dispense with them as an important article of diet, and particularly since the production of this class of foods can be maintained, at least to a very large degree, on materials that are of little or no value as food for human beings. In effect, it may be said that through the agency of the dairy cow, humanity is able to graze the waste lands and to eat the roughage from the fields. It seems entirely feasible that some of the overcrowded countries where dairying does not exist at present will in time, as their agricultural system improves and the customs of their people change, develop a substantial dairy industry.

It is safe to conclude that at least for many generations yet to come the demand for dairy products as a large part of our food supply is going to be very extensive.

### CONTAGIOUS DISEASES.

This is perhaps a little foreign to the subject of the paper, but it is vital to any comprehensive consideration of the dairy industry and for this reason it is discussed briefly here.

Contagious diseases among cattle constitute one of the serious difficulties that lie in the way of a full development of dairying. It is a matter which does not relate wholly to the healthfulness of the food, for it has an important economic bearing upon production as well. The eradication of tuberculosis, for example, has often been advocated solely on the basis of protection to human health; yet, with tuberculosis in his herd, no dairyman can realize the greatest and most economical production. It is necessary, therefore, that this question be considered from the standpoints of both the consumer and the producer.

Contagious diseases constitute increasingly serious problems in the dairy industry. This is owing, in part at least, to our present custom of transporting animals freely from one section to another. By this means contagion may be rapidly distributed to all parts of the country. The recent outbreak of foot-

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and-mouth disease in the United States is a most striking example. While the small dairyman possesses some marked economic advantages, he is usually not qualified to cope with these diseases. Contagion of one kind or another occurs in his herd, and so long as there is not some immediate and striking effect he is inclined to minimize its seriousness, although little by little it may be destroying his business. Often, by reason of lack of appreciation of the danger, he takes no precautions to protect his neighbors, and they, equally uninformed as to the effects of the contagion, are also indifferent. It often occurs, therefore, that a contagious disease, like abortion, little by little destroys a large part of the profits of the dairying in an entire community before any of the farmers in the community realize the seriousness of what is going on. Contagious abortion alone is costing the dairy industry in this country many millions of dollars annually.

A disease which produces serious results immediately causes alarm, and in such cases it is sometimes possible for sanitary officers to receive sufficient money and support to stamp it out, as has been the case with the recent outbreak of foot-and-mouth disease.

The slow diseases, the results of which are gradual, and which go unnoticed until much damage has been done, create a situation far more difficult to handle.

How is this situation to be met, in the case of the average small farmer, upon whom we must rely for the bulk of our dairy products? Can it be done through education and cooperation? The whole community, and not one farmer alone, must deal with such a question. If contagion occurs on a single farm, steps must be taken immediately to stamp it out, but something more is necessary. Steps must also be taken to prevent the carrying of the contagion to neighboring farms, and in this the neighbors must assist. Three things therefore are necessary: First, to appreciate the seriousness of the disease; second, to know what to do to stamp it out; and, third, to get the community to act so as to prevent its spreading before it is stamped out. Much can be done through education, but something more is necessary.

The State live-stock sanitary officers should have adequate authority and facilities to take personal control of all outbreaks of contagious live-stock diseases. A competent officer who will instruct the people what to do should be sent to the locality in which contagion appears. If necessary he would establish a quarantine and take other steps to effect a most prompt eradication of the disease. If the right kind of men are employed for this work the public expense should not be great, for in many cases, under proper leadership, the farmers of the community affected would gladly do what was necessary to stamp out the disease.

Such a system sufficiently adequate to deal with contagious diseases among all domestic animals would not entail great expense, for under ordinary circumstances one officer could doubtless take care of several counties. It is believed that the saving which could be effected in suppressing hog cholera alone would justify the expense required. Unless some more effective system than is now in operation in this country can be developed, the time is approaching when only an expert in animal diseases will be able profitably to breed and produce domestic animals, and then only when he has no near neighbors. Some more effective method whereby the small farmer may be aided in coping with this question must be found if he is to continue in the live-stock business, and he must do so if adequate live-stock production is to be maintained and if our agriculture is to be developed along comprehensive lines.

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IS DAIRYING PROFITABLE?

Perhaps there is no better way to judge of the profitableness of an industry than to consider the financial standing of the people in communities which have long been devoted to it. We find the dairy communities of the Nation among the most prosperous communities. Dairying is generally found in regions where land values are high; in fact, it seems to raise these values. It often successfully replaces other industries which have failed, and it is generally recognized that dairying, when properly conducted, is one of our most profitable agricultural industries.

To review briefly, dairying offers greater possibilities for maintaining soil fertility than are offered by any other single industry. It converts a large amount of comparatively useless material into nutritious food for human beings. It favors intensive farming and the small farm as a unit, and hence is a factor in conserving the lands. It fosters a type of agriculture that is constructive in nature. It favors an economical utilization of labor, using large quantities which otherwise would be unproductive. It contributes largely to the national food supply and furnishes a needed substitute for meat. It is an important factor in the food supply of the farm. It is adapted to a highly developed type of agriculture, conducted on high-priced lands. In short, it is profitable and likely to remain so.

We must realize that there is much yet to be done in developing this great industry. There is inefficiency on every hand; unprofitable cows are being kept; often inferior products are sent to the markets and sold at low values; animal diseases are uncontrolled. Therefore in considering the future possibilities of this industry, its requirements of the future as well as its accomplishments of the past must be taken into account.

Considering the dairying industry in connection with agriculture at large, and taking into account the history of agricultural countries in which dairying has for centuries demonstrated its usefulness and its value, and taking into account also the state of our own agriculture, which is much newer and less developed, it would seem fair to conclude that dairying, developed in a proper manner, is an indispensable industry, both as a source of human food and as an important part of an efficient and permanent system of agriculture.

This consideration of the question has been made from a standpoint of conditions in the United States. It is believed, however, that dairying possesses certain essentials that are fundamental in any well-developed system of agriculture. Its relation to the fertility of the land, the distribution of labor, and the independence of the small farmer, its effect on the food supply, and its relation to various agencies of civilization, are believed to be of vital significance to any country.

The CHAIRMAN. Does anyone wish to discuss this extremely interesting and remarkable exposé of the dairy situation in America?

Mr. COOK. I hope Dr. Rawl will go right ahead with this point, the necessity of organized effort, which applies in so many agricultural lines. It is as reasonable to expect that people are going to help themselves up by pulling their own boot straps, as to suppose that individual farmers can protect the community against an infectious disease. Systems for doing such things must be worked out. It is perfectly plain that our social organization is not developed for dealing with that class of cases. While we had a few

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people scattered widely all over the country, the individual farmer was in a measure protected from diseases as well as from contamination of his cotton seed, but as our population increases, the communicable diseases will also increase; and unless we meet them in more intelligent and efficient ways, our civilization will inevitably suffer.

The following papers were presented and read by title at this session:

Cattle-raising and the meat industry in southern Brazil, by Reynaldo Porchat.

Algo sobre la langosta (schistocerca Americana) y la necesidad de una convención internacional para obtener su destrucción, by Juan J. Rodríguez Luna.

The Institute of Tropical Agriculture of the Pacific Coast, by Herbert J. Webber.

## CATTLE RAISING AND THE MEAT INDUSTRY IN SOUTHERN BRAZIL.

By REYNALDO PORCHAT,

*Professor of the Faculty of Law of São Paulo, Brazil.*

Among the most promising industries in Brazil at the present time, cattle-raising and the packing-house industries are receiving the most attention; and my connection with two of the largest companies in Brazil in these branches of industry authorizes me, I think, in putting before the American public, and especially to those interested in these industries, some information which may be of interest to them, and show them what opportunities the Brazilian Republic offers to intelligent and energetic cattlemen and for the establishment of packing houses.

Brazil has a population of over 22,000,000 inhabitants, and occupies an area of 8,524,770 square kilometers, or rather more than the area of the United States of America, excluding Alaska. It has some very large cities, as, for instance, Rio de Janeiro, the Federal capital, which has over 1,000,000 inhabitants, and is considered as among the most beautiful cities of the world. São Paulo, the capital of the State of São Paulo, the Manchester of Brazil, has 450,000 inhabitants and is the second city of the Republic. There are also numerous other large cities up to date in every way, with all the comforts of modern civilization.

### LAND.

Brazil has a large variety of lands suitable for farming and stock raising. The States of Rio Grande do Sul, Santa Catherina, Parana, Matto Grosso, Minas Geraes, Goyaz, and São Paulo are all suitable for the carrying on of these industries. A great variety of good crops can be raised on these lands, and cattle are easily raised on their grassy plains, no artificial feeding being necessary in the wintertime, as green grass is always on the ground for them to feed on. Brazil is a particularly well-watered country, especially the southern States, regarding which I am speaking at the present time, as the land rises

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to a plateau of about 2,000 feet above sea level all around the coast, and the majority of the rivers have their source near the coast and then run inland for about 1,000 kilometers and eventually find their outlet in the River Plate, in the Argentine. This is a very favorable factor in stock raising and other pursuits. The soil is generally, all over southern Brazil, very good, but this is especially so in the State of São Paulo, which has a rich deep-red loam soil, eminently suitable for the growing of crops of all kinds, such as coffee, corn, beans, rice, cotton, bananas, pineapples, and oranges, which are all largely grown, besides an abundance of other crops and fruits.

### CLIMATE.

The climate of Brazil generally is a very pleasant one. For a stretch of about 10 miles inland, all along the coast of the southern States, which is practically on the sea level, before mounting the plateau, the climate is tropical or semitropical, where all tropical fruits, such as bananas, coconuts, etc., are grown in great abundance and to great advantage. Inland, however, once the plateau is reached, the temperature is much cooler, especially in the evenings, and there all kinds of crops and fruits of the semitropical and temperate zones can be grown in great quantities. The average rainfall is about 42 inches per annum, the rainy season being during the hot months, i. e., November, December, January, and February, the coolest months being June, July, and August. The average temperature in the State of São Paulo in summer is 22 to 25° C. and in winter 15 to 17° C. The States of Minas Geraes, Goyaz, and Matto Grosso are rather warmer, and the States of Parana, Santa Catherina, and Rio Grande do Sul rather cooler. In all these States it is possible to cultivate the whole year round.

### GRASSES.

There is a great variety of grasses in Brazil suitable for cattle grazing. In the State of São Paulo there are two kinds of native grasses which are being very extensively planted for fattening cattle, called "Cattingueiro roxo" and "Jaragua." They are easily sown and are considered by some as being equal to alfalfa for cattle fattening, and are destined to do for Brazil what alfalfa has done for the cattle industry of the Argentine Republic. There are, of course, a large number of other very good grasses, and some of the North American grasses grow very well here.

### PRICE OF LAND.

Suitable land for stock raising and agriculture can be acquired in the States named at about the following prices per acre and according to quality and distance from railroads: Minas Geraes, 25 cents to $2; Matto Grosso, 25 cents to 50 cents; Goyaz, 20 cents to 40 cents; Parana, $2 up; Santa Catherina, $2 up; São Paulo, $1.50 up. These prices are for large blocks of land, some of which extend to from 150,000 to 1,000,000 acres in the States of Minas Geraes, Goyaz, and Matto Grosso. As will be seen, Brazil has, perhaps, cheaper land, the quality being considered, than can be obtained in any other part of the world.

My American friends know better than I do the rapidity of the development of the Western States of America, Canada, and the Argentine, and can appreciate the great opportunities there are in Brazil at the present time. In all these countries, the value of land went up in a few years by leaps and bounds, and there is no doubt but that land in Brazil will also go up at the same rapid

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rate in the near future, when the opportunities for farming and stock raising are realized by the outside world. Even in Rio Grande do Sul, the State which adjoins the Republic of Uruguay, the rise in price of land has been phenomenal. Lands which were selling for $20,000 per league there five years ago can not now be acquired for double the price; and the best lands in Rio Grande are now selling at $150,000 per league of 4,356 hectares. The best lands in the Argentine Republic are now selling for $400,000 to $450,000 per league of the same size. It will be seen, therefore, that there is a vast margin for an increase in value in land in Brazil, and that it will never be lower than it is at the present time is a certainty.

STOCK.

Cattle raising is already a well-developed industry in Brazil, and, as will be seen from the statistics which I give below, this country ranks as among the large breeding countries of the world. The Government statistics for 1913 give the animal population of Brazil as follows:

| | Head. |
|---|---|
| Cattle | 30,705,000 |
| Horses | 7,289,000 |
| Mules and donkeys | 8,208,000 |
| Goats | 10,049,000 |
| Sheep | 10,653,000 |
| Hogs | 18,399,000 |
| Total | 80,303,000 |

The present price of cattle for breeding and fattening purposes is as follows:

| | |
|---|---|
| Steers, 4 years up:[1] | Cows, 3 years up: |
| In Minas Geraes 80$000 | In Minas Geraes 55$000 |
| In Matto Grosso 80$000 | In Matto Grosso 50$000 |
| In Parana and Santa Catharina 105$000 | In Parana and Santa Catharina 85$000 |

Cattle are fattened here on grass only, and cattle fattened on Catingueiro roxo and Jaragua grasses are at present being exported to Europe and the United States. Owing to the absence of severe winters, cattle feeding as is done in the United States is not resorted to here, as there is no necessity, there being always plenty of green grass on the ranges and fattening pastures. The average price of live stock and some other goods in the São Paulo market is as follows:[1]

Steers, fat, 180$000 to 190$000 per head.
Hogs, 14$500 per 15 kilos dead weight.
Corn, 7$000 per sack of 100 liters.
Beans, 14$000 per sack of 100 liters.
Rice, uncleaned, 12$000 per sack of 58 kilos.
Rice, cleaned, 24$000 per sack of 58 kilos.

The 1$000 on a normal exchange is worth 33 cents, but at present it is only worth 25 cents.

*Hogs.*—Hogs are very easily raised in Brazil and are most prolific, and are particularly free from disease in this country. Owing to the facility with which hog feed can be grown, such as mandioca, corn, etc., this is a most profit-

[1] Prices quoted for 1917.

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able industry in this country. A large number of hogs are at present being raised in Brazil, but the native types, although hardy, large, and fine animals, are not what are called bacon hogs, as their fat is too thick and there is not enough lean. Owing to this the export of bacon and hams from Brazil is at present handicapped, but this is, however, being rapidly corrected, there being a very accentuated movement in the direction of breeding to imported boars; and all the well-known breeds of hogs seem to thrive well in this country, there being now quite a number of breeders with a nucleus herd of Poland China, Duroc Jerseys, Berkshires, etc. Hog feed being so easily raised in this country, such as pumpkins, mandioca, corn, etc., and also a variety of grasses, and hogs generally being so free from disease, the industry is capable of being very extensively increased, and besides having a ready market in this country, the packing houses now established here are large consumers for export. Brazil has the advantage over the Argentine in this industry, as we have a large number of hogs, and the Argentine has not.

REMARKS ON STOCK RAISING.

Owing to the action of the largest stock-raising company in Brazil, the Brazil Land, Cattle & Packing Co., pure-bred hogs and cattle are being introduced now very rapidly into this country, and this fact should tend to improve the breed of the country. I may say that this company appears to have solved the question of importation of pure-bred cattle from foreign countries, as the loss suffered by their last importation from Texas fever, etc., was insignificant. The company has imported altogether over 1,300 head of pure-bred cattle, and it is the opinion of Mr. Murdo Mackenzie, who I am sure is well known to the cattlemen of the United States, that the Hereford is the most suitable breed for Brazil; and as he has met with great success in their introduction into this country from the United States, it seems to me that there is a fine opening here for American breeders to export pure-bred cattle to Brazil. The introduction of pure-bred cattle is encouraged by the Government of Brazil, and breeding cattle enjoy reduced transportation on the railways of the country.

Stock raising can not be too highly recommended to intending settlers in Brazil, as there is no doubt but that this industry can be made a profitable one if worked energetically by ranchers and farmers, who will find that the Government of Brazil is very much alive to the benefit which will accrue to this country with the development of these two industries, and every encouragement and help is given by the Government departments. Brazil has cheap lands such as no other country has, and the prospects of a rise in value is therefore greater. Argentine lands are now too dear; Australia is too far from the European markets, and it is also subject to periodical drought, and Southern Brazil is not.

I would repeat that there seems to be no doubt as to the future of the animal industry in Brazil. As you are aware the United States of America has become an importer of meat, both the Atlantic and Pacific ports have been receiving, during the past two years, chilled and frozen beef and mutton from Argentine, Australia, and New Zealand, in increasing quantities—a fact which, a few years ago, would have been considered like carrying coals to Newcastle. This can not be otherwise if we look at the ever-increasing population of the United States and the rapidly decreasing number of cattle on the ranges. This is probably due to a large extent to the breaking up of the ranches in the Western States, due to the increasing value of land, making it too valuable for cattle raising, better results being obtainable from the soil by

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agriculture. The only real large cattle-exporting country at the present time is the Argentine. The development of the cattle industry in the Argentine has been extraordinary, but owing to the very heavy exports, Argentine is not increasing its herd but rather decreasing. The growing of grain, moreover, is encroaching on its cattle ranches as occurs in all countries where land has increased in value to such an extent as is now current in the Argentine. The fact that Brazil has already a cattle population equal in size to that of the Argentine, to form a basis for future development, seems to point to southern Brazil being one of the future large suppliers of the world's requirements of meat.

PACKING HOUSES.

I now come to the subject of packing houses, and in this industry private enterprise is supreme if the opportunity which Brazil presents for the development of this industry is to be made use of. The raising of stock of all kinds is being fostered by the Government in every way, such as cheap transportation of materials, free transportation of seeds, free veterinary assistance, etc., but the animal industry is dependent on packing houses to find a market for the products of their ranches, farms, etc.; and packing houses can not be established by the Government, and it is therefore up to private enterprise to seize the opportunity to establish themselves in this country, where they will be so well placed, especially now that Brazilian meat is meeting with such a ready sale and taking a position for itself in the European and American markets. This industry is still in its infancy here, and its exploitation should be very remunerative. As will be seen from the statistics above, Brazil has a very large number of cattle, and the exportation of meat is practically nil. This is not through any difficulty in the exploitation of the business in this country, but to the fact that till lately Argentine absorbed all the attention of the packing house industry of the United States, and Brazil was practically ignored. However, with the rise in the price of beef all the world over, including the Argentine, owing to the large export demand, and consequent large exportations from that country, and the dropping off of the United States as an exporting country, Brazil is now beginning to come into its own. We have already two packing houses lately established which are working to their full capacity exporting beef to the United States and Europe, where, to the surprise of the dealers, Brazilian frozen and chilled beef were found to be equal in quality to Argentine beef, and cheaper. With this fact, and in view of the much cheaper price of cattle in Brazil as compared with the Argentine (Brazilian steers, fat, cost 185$000, as against 350$000 in the Argentine), it will be seen that these two frigorificos are very advantageously placed. One of them is managed by one of the large American packing-house concerns, Messrs. Sulsberger Sons Co., and the other is a native company, Companhia Frigorifica e Pastoril, and I hope that in the not distant future we may be able to welcome in our midst other American and European companies to our mutal benefit. There is plenty of room in Brazil for more packing houses as there is plenty of cattle in the country. The native Brazilian cattle are large animals, and are of exportable quality if properly fattened, as has been abundantly proved by the recent exportations, and the native breeders are awakening to this fact, and bunches of cattle have been killed and exported lately by the packing houses here weighing well over 660 pounds dressed weight. Owing to the demand for well fattened cattle by the packing houses, large areas in the State of São Paulo are being transformed into cattle-fattening pastures, assuring a fine future for the supplying of meat of exportable quality to the packing houses.



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New packing-house companies establishing themselves in the State of Sao Paulo will find a Government and public authorities already accustomed to the requirements of the packing-house industry, which is of great advantage in establishing an industry in a new country. The railways in the State of Sao Paulo are quite alive to the importance of this industry and are already increasing their rolling stock to meet all developments. I have also just heard that two of the largest French shipping companies are fitting a number of their ships with refrigerating plants to enable them to transport frozen and chilled meats. This is consequent on meat being admitted into France free of duty, whereas formerly it was heavily taxed. France from now on will be a heavy importer of foreign meats, as its herd has been very much depleted owing to the war.

Sao Paulo, it seems to me, is destined to be the Chicago of Brazil, owing to its favorable position, being the center of many railway systems going into the interior, facilitating the supply of live cattle to the packing houses, and, at the same time, owing to its proximity to Santos, the exportation of the product of the packing houses is quite easily made through that port, or even via Rio de Janeiro, as Sao Paulo is connected directly with that port by the Central of Brazil Railway.

I hope that the above information I have given will be of some use to those in the United States who are interested in the stock-raising and packing-house industries in this country, and that it may be the means of Brazil being more widely known in the United States.

## ALGO SOBRE LA LANGOSTA (SCHISTOCERCA AMERICANA) Y LA NECESIDAD DE UNA CONVENCIÓN INTERNACIONAL PARA OBTENER SU DESTRUCCIÓN.

Por JUAN J. RODRÍGUEZ LUNA.

*Entomólogo, Guatemala, Guatemala.*

Muy bien conocido y muy bien tratado está, desde hace muchos años, el asunto: "Animales perjudiciales a la Agricultura."

Varios mamíferos, gran número de aves e infinidad de artrópodos son los grandes enemigos de las siembras. Comienzan sus ataques desde que la semilla cae en el surco, los prosiguen continuamente hasta la época de las cosechas, y, en ocasiones, no se detienen ni ante las murallas del granero.

Los insectos, con excepción de algunos dípteros e himenópteros, son los más nocivos; y los daños que causan son incalculables o, reducidos a cifras, alcanzan proporciones que amedrentan.

Voy a ocuparme en este trabajo sólo de una especie, correspondiente al orden: orthoptera; fam.: acridæ; sub-fam.: acridiinæ, llamado por Drury Schistocerca americana, y conocido en Centro-América y México con el nombre vulgar de Chapulín. Sus invasiones pueden compararse con las epidemias, pues así se desarrollan y transmiten y tienen, como éllas, períodos más o menos largos.

La multiplicación asombrosa de esos Acrididos, y su instinto migratorio, que les lleva de una a otra comarca y de un país a otro, siguiendo un derrotero fijo, más o menos inclinado al Norte o al Sur, y sin encontrar valla ni obstáculo que los detenga, les constituye en uno de los más grandes peligros de la Agricultura. Su llegada es siempre de resultados funestos para los dueños de

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fincas rústicas y en general, para toda la nación invadida, porque el chapulín destroza de preferencia los campos cultivados y a menudo los agosta; y aunque se resiembren muchas veces, otras tantas consume el voraz ortóptero las tiernas plantas en que el labrador había puesto sus esperanzas mejores.

En los tiempos pasados tras una invasión del chapulín se presentaba el hambre. Hoy, gracias a la facilidad de comunicaciones con países distantes es raro llegar a ese extremo; pero el empobrecimiento siempre resulta en la nación devastada. No debe olvidarse que en la América Hispana el maíz y otros cereales atacados por el ortóptero son la base de la alimentación de la mayoría de los habitantes.

Sucede con esta que llamo epidemia de la langosta, lo que con algunas otras; por ejemplo: la influenza. Alarma mucho y se trata de combatirla bien o mal mientras está presente, pero después se olvida y no se da ningún paso para prevenir nuevas invasiones. Por lo regular tampoco deja rastro en la historia. De las muchas veces que probablemente arribó el chapulín a Centro-América durante el período colonial, pocas quedaron consignadas, y aún de éstas sólo dos con amplitud: la de 1632, descrita por el Padre Thomas Gage, en sus "Viajes," que la llama plaga parecida a la de Egipto y que fué terrible y destruyó las plantaciones de añil, caña de azúcar, algodón, maíz y trigo; y la de 1798–1807, de la cual hay acopio de datos en la "Gaceta de Guatemala," publicación de aquella época.[1]

Desde la Independencia (1821) para acá ha aparecido cuatro veces. Durante 1852, 1882 y 1895, procedía de países situados al Sur de Centro-América. La actual invasión, que tenemos desde 1913, entró por México; es decir, por el Noroeste, y su extraordinaria fuerza numérica se atribuye a que, por motivo de los disturbios políticos y guerra civil en que está envuelta la vecina nación, no se hizo absolutamente nada en ella para destruir la plaga y evitar la propagación de los dañinos visitantes; y aunque estos han sido ya casi exterminados en el territorio guatemalteco, persiste el riesgo de nuevas y próximas invasiones, porque sigue germinando el Acridio en las extensas y poco pobladas comarcas fronterizas.

Es de esperarse que la paz imperará pronto en México: y que regularizado el orden en esa industriosa y rica nación, entre con todos los demás pueblos medios el chapulín o langosta migratoria.

Con el sistema que podría llamarse primitivo o casi fundado en el instinto, cual es el de espantar las manchas o nubes del volador, o sea del insecto en su estado perfecto, con ramas, gritos y ruidos hechos con toda clase de instrumentos, sólo se obtiene que las manchas pasen de un sitio a otro cercano. A lo que debe aspirarse es a destruirlas, ya envenenando los huevos o rompiéndolos mecánicamente; ya sepultando o aniquilando a los saltones, que es como llaman al chapulín cuando todavía no vuela; ya, en fin, envenenando al volador o comunicándole, por medio de microbios, enfermedades mortales y contagiosas.

Aunque los medios hasta hoy descubiertos y empleados para combatir la plaga no sean aisladamente por completo eficaces, usados todos en combinación dan excelentes resultados, principalmente cuando se dirigen contra el saltón[2] y los huevos; pero debe confesarse que en la lucha todo esfuerzo no secundado, todo esfuerzo que no sea general, resulta casi improductivo. Si un

[1] El ilustre naturalista Director del Museo Nacional de Costa Rica Sr. Don Anastasio Alfaro, en un interesante opúsculo "La invasión de la Langosta," de Octubre, 1915, que recibí hace poco, hace referencia a invasiones en 1659, 1731, 1774, 1800; pero siempre se ve que faltan en nuestra historia otras.

[2] Así llamado en estado de larva antes de su metamorfosis con élitros y alas.

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cultivador, por ejemplo, o un municipio, logra con dedicación y constancia exterminar el Chapulín, y el vecino no lo hace, poco se habrá aprovechado. Lo mismo cabe decir respecto de las naciones limítrofes. La lucha contra el Acridio debe ser simultánea, unánime y constante en todas las regiones ocupadas por él; y ese resultado no podrá alcanzarse prácticamente mientras todos los gobiernos de los países visitados por el insecto peregrino no se pongan de acuerdo en dictar leyes apropiadas.

Dichas leyes tienen que ser el objeto de una convención, y deberán inspirarse en conocimientos prácticos y científicos, para ser efectivas; tener carácter internacional, porque la indiferencia de un Estado puede ocasionar graves daños a sus vecinos; y ser coercitivas, porque en naciones en que, como en varias de las hispano-americanas, existe una gran proporción de indios, todavía analfabetos y, además, desidiosos y fatalistas, no cuentan los móviles del interés individual y de la propia conveniencia.

Las pérdidas que se evitarían extinguiendo la langosta son incalculables. Baste recordar que sus invasiones son tres o cuatro o cinco en cada siglo, y aún más en ciertas zonas, y que algunas de ellas duran varios años.

El Congreso Científico, patrocinando mi idea, puede recomendar a todas las naciones en él representadas, que celebren la convención a que me he referido y a la cual cabría que se adhiriesen las demás. Este es el objeto de la presente comunicación.

No he querido molestar la atención de esta ilustre Asamblea, hablando sobre las costumbres y vida de la especie de orthoptera en que me he ocupado, porque son bien conocidas no sólo en América, sino en el Viejo Constinente, por existir allá el Œdipoda migratoria, que las tiene iguales aunque se presenta con más frecuencia por guarecerse en los desiertos del Norte de África.

Tampoco he creído entrar en pormenores respecto de los procedimientos conocidos para la destrucción del formidable enemigo, ni mencionar los nombres de algunos insectos, entre los cuales se cuentan las larvas de varias especies de moscas y que auxilian al hombre, aún más valiosamente que las aves, en la lucha contra la Œdipoda y la Schistocerca, según se ha comprobado en África y en Guatemala. Esas disertaciones no son indispensables para el fin que persigo, y habrían hecho demasiado extensa la presente comunicación.

ADICIÓN.—No ignoro que en la República Argentina a causa de la gran extensión de su territorio y las pampas, las invasiones de la Schistocerca son casi endémicas, y que existe una Sociedad llamada "de Defensa" para combatir a tan perjudicial Ortóptero. Ya se ha ensayado allá el Cocobacilo de Mr. D'Hérelle, quien, notable bacteriólogo, lo descubrió y experimentó en Yacatama; en esta última invasión que hemos tenido en Centro-América trató de emplearse tanto en Guatemala, como en Honduras y en El Salvador. Eso requiere Laboratorios y constancia; pero no podrá negarse que científicamente debe recomendarse. A este propósito transcribo ahora lo que referente a L'inoculation des Santerelles, trae en la parte: Echos et comunications, el periódico "L'Illustration de Paris" del 15 de Diciembre último. Dice así: "Des procédés fort divers ont été mis en œuvre pour se protéger contre les nuces des sauterelles qui ravagent périodiquement les terres du Nord de l'Afrique; ces procédés sont plus ou moins dispensieux, et la mesure de leur efficacité est fort variable.

"En ces dernières années, on a employé le virus d'un bacille qui fut isolé, en 1910, au Mexique où il avait provoqué une épidémie spontanée parmi les sauterelles. Le mode opératoire présentait, jusq'ici, certaines lacunes. Dans une note présenté à l'Académie des Sciences par M. Laverán, Monsieur D'Hérelle a apporté des perfectionnements sérieux à la préparation du virus. En desséchant des cadavres des sauterelles infectées, l'auteur obtient une poudre, qui enformée dans des tubes, conserve sa virulence pendant deux ans. Il suffit de délayer cette poudre dans l'eau et mettre la préparation à la portée des sauterelles pour provoquer une épidémie qui les décime avec une grande rapidité. La méthode a donné d'excellents résultats cette année en Fénisie."

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# THE INSTITUTE OF TROPICAL AGRICULTURE OF THE PACIFIC COAST.

By HERBERT J. WEBBER,

*Dean, Graduate School of Tropical Agriculture, University of California.*

At the request of Dr. Fairchild, of the United States Department of Agriculture, I consented to present a paper on the above subject, although no institute by that name exists, so far as I am informed.

Fifteen years ago when the writer was associated with Messrs. D. G. Fairchild, W. T. Swingle, and others in the United States Department of Agriculture in the study of subtropical and tropical plants, the importance of having some institution in the United States where special studies with such crops could be prosecuted was frequently discussed. Since that time the importance of tropical and subtropical fruits in the United States' markets has increased to more than double. We who know the situation, however, know that even yet our markets are in large measure ignorant of many very valuable fruits that should be made available for our people, and even those that are known are available in such limited quantities that no regular demand can be built up for them. The supply of strictly tropical plants for the United States markets should naturally come mainly from the American territory to the south of us—Mexico, the West India Islands, and Central and South America.

The great difficulty that confronts the building up of fruit interests in these countries based on markets in the United States rests largely on the danger of importing into the United States on such fruit, insect, and fungous diseases that might possibly be dangerous to the success of our home-grown crops. That this difficulty is a very real and vital one is illustrated by the condition of the fruit industries of the Hawaiian Islands. By the present time very extensive industries in the growing of avocados (ahuacates), mangos, papayas, and the like for the markets of the United States would have been built up had not the extensive spread of the Mediterranean fruit fly in Hawaii rendered it unsafe to ship such fruits into the United States. This made it necessary for the United States Government to prohibit the admission of any fruits that might possibly be infested to our markets from that territory.

Similar damage has been done to the Mexican fruit interests by the presence of the Mexican fruit fly. The interrelation of our agricultural interests, it will be clearly seen, becomes a very important matter, equally of interest to consumers in the United States and to producers in neighboring tropical countries. There is clearly need for schools where such matters are carefully studied.

Again, it may be said that the Tropics and tropical agriculture possess a lure that has attracted and will continue to attract many of our citizens. Places should exist in the country where special training in this type of agricultural work may be obtained.

Another side to the same question is presented by the large number of students that come to American universities and colleges of agriculture from Central and South American countries. A very large proportion of such students come to this country to obtain special instruction in agriculture. Naturally they desire particularly to study those industries with which they will be most concerned in their own countries. I know this personally from my experience in Cornell University with students from South American countries. Many such students desired to prepare theses on the growing of cotton, sugar cane, oranges, tropical fruits, and the like. Such students could get

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special training in cotton growing at several of the colleges of agriculture in the Southern States. Training in subtropical fruit growing to a certain extent was given at the University of California at Berkeley and at the University of Florida at Gainesville. Both of these institutions, while in States famous for their subtropical and tropical fruit productions, are located a considerable distance from the regions where such fruits are commercially grown. They do not, therefore, meet the great need by furnishing a place where tropical and subtropical horticulture can be studied in the midst of large commercial plantings of such fruits.

An institution that may ultimately fulfill this mission has recently been established at Riverside, Cal., under special act of the State legislature. This is the Graduate School of Tropical Agriculture and Citrus Experiment Station, established as a branch of the College of Agriculture of the University of California, and administered by the regents of that institution. To provide for the beginning of this institution the legislature appropriated $60,000 for the purchase of the necessary land and water rights; $100,000 for laboratory buildings; and $25,000 for director's residence, barns, tool houses, and the like. For several years the university has maintained two small stations in southern California—namely, the Citrus Experiment Station at Riverside and the Southern California Pathological Laboratory at Whittier. These two stations are to be united in the enlarged new institution.

The location selected and purchased for the new institution embraces a tract of 475 acres of land, located 2½ miles from the center of the city of Riverside in the southern part of California. Riverside is a town of 20,000 inhabitants and is considered to be one of the most beautiful cities in Californa. It is in the heart of the orange section, there being about 60,000 acres of citrus orchard within a radius of 20 miles of the station site. Three railways passing through Riverside make the location easily accessible, and it is only 56 miles distant from Los Angeles—a modern city of 500,000 inhabitants.

The institution has as its main function the conducting of research on problems connected with subtropical and tropical horticulture. The investigations will deal especially with problems connected with the prosecution of subtropical and tropical horticulture under irrigation. Horticultural interests dominate in southern California, and although half a century or more has passed since the first horticultural plantings were made, these industries are still in a pioneering stage. In scarcely any case can definite answers be given regarding the best methods of manuring, cultivating, pruning, and the like, although very extensive and profitable industries have developed. The plan is therefore to limit the work primarily to horticultural investigations in the belief that greater good can be accomplished by a concentration of the efforts on a comparatively few major problems.

Experimentation should go hand in hand with teaching, and an experiment station where investigations are being prosecuted on various subjects becomes a place of special interest and instruction, particularly for advanced students. It was thus the idea of those planning the institution that it should furnish facilities for the teaching of advanced students that are preparing themselves to be investigators, and the Graduate School of Tropical Agriculture was thus included as a part of the institution. The necessity to teach ordinary students is a great handicap to investigation, and it has been found necessary in the agricultural college and experiment station to separate largely the teaching and investigation functions if both are to be handled successfully. Graduate students, however, come in a different class. They take up special subjects, and the professor, by assigning to them topics for investigation on which he

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desires information, is able to extend his ideas and get more good work done than he alone could possibly accomplish. The graduate school, therefore, it is believed, will be a valuable part of the institution, enabling many young men to obtain training in special investigations and at the same time greatly increase the volume of the investigation that can be handled. As the teaching work is limited to graduate students the number of students attending the institution will naturally be comparatively few. There is, however, an increasing demand for highly trained men, and it is hoped that this branch of the work will ultimately become important.

While the work of construction of the new station is under way, the organization of the faculty and of the experiments is being pushed as rapidly as possible from the headquarters of the old Citrus Station at Riverside and the pathological laboratory at Whittier. The following is a list of the scientific staff at the present time: H. J. Webber, Ph. D., D. Agr., dean and director, and professor of plant breeding; J. T. Barrett, Ph. D., professor of plant pathology; W. P. Kelley, Ph. D., professor of agricultural chemistry; H. J. Quayle, M. S., professor of entomology; H. S. Reed, Ph. D., professor of plant physiology; H. S. Fawcett, M. S., associate professor of plant pathology; L. D. Batchelor, Ph. D., associate professor of plant breeding; R. S. Vaile, B. S., assistant professor of orchard management; H. D. Young, B. S., assistant in agricultural chemistry; C. O. Smith, M. S., instructor in plant pathology; E. E. Thomas, B. S., assistant chemist; W. M. Mertz, superintendent of cultivations; H. B. Frost, Ph. D., instructor in plant breeding; C. P. Clausen, B. S., assistant in entomology.

The climatic conditions at Riverside are very favorable for graduate work on problems connected with tropical and subtropical agriculture. It is possible here to grow a very large range of crops. In addition to many tropical and subtropical fruits, the majority of Temperate Zone crops can be produced here. The region is semiarid, irrigation being required in the growth of most crops. The institution is, therefore, advantageously located for the study of problems related to irrigated agriculture. Probably nowhere in the world have the methods of irrigation reached higher perfection than in the citrus industry of southern California. The laboratory site is immediately surrounded by cultivations of oranges, lemons, pomeloes, avocados, guavas, loquats, olives, apricots, peaches, pears, European grapes, and Persian walnuts. Near-by areas are devoted to the cultivation of wheat, oats, barley, and other dry-land crops. The climatic conditions are such that plants grow throughout the entire year, there being only a slight lessening of growth during two months of the winter period. Probably nowhere in the United States could a region be selected more favorably situated for the study of problems connected with subtropical agriculture and horticulture.

The new site of the station is now in course of development. Next spring a 100-acre citrus grove will be laid out and planted. This is to be used entirely for a fertilizer, irrigation, and cultivation experiment, and the trees to be planted have been selected and grown particularly for this purpose. There will also be planted next spring a citrus variety orchard. The collection of trees for this purpose already contains about 500 different sorts. Collections of tropical and subtropical fruits for trial on the station grounds are being made as rapidly as possible, and the gardens will soon furnish abundant material for observation and study.

A small experiment station has been maintained by the university at Riverside for the last nine years, and the 24 acres of land at this old station and the experiments already under way there will be maintained. This tract, which

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is all planted, contains: (1) A fertilizer experiment of 22 half-acre plats that has been under way nine years; (2) an experiment with different stocks for citrus trees, also in its ninth year; (3) a cover crop experiment in its sixth year; (4) a citrus variety orchard containing about 150 different sorts.

Another experiment, consisting of 98 plats, is underway near Riverside on a 25-year-old grove for the purpose of demonstrating the value of various fertilizers, methods of cultivation, and irrigation in the rejuvenation of an old, run-down citrus grove. Other experiments carried on in cooperation with growers are located in various sections. The experiments underway are of great value to students, enabling them to gain a first-hand knowledge of experimental methods and furnishing many special problems for investigation.

The new laboratory buildings are under construction and are expected to be ready for occupancy in the fall of 1916. They are especially designed as research laboratories and are supplied with standard equipment, such as water, gas, electric light, electric power, compressed air, and vacuum. The old laboratories of the Citrus Experiment Station at Riverside and the Southern California Pathological Laboratory at Whittier will be retained and utilized as long as necessary.

The results of the investigations and researches carried on at the citrus experiment station are published in the regular series of bulletins of the college of agriculture and in the agricultural science series of the university publications. These publications will furnish facilities for the printing of special researches carried on by students when they are of suitable nature.

In the organization of the Graduate School of Tropical Agriculture and Citrus Experiment Station the following divisions are represented at the present time: Agricultural chemistry, entomology, orchard management, plant breeding, plant pathology, and plant physiology. The institution is organized primarily for research, and no regular course of lectures are given. Student instruction will be carried on primarily as special courses in investigation. The various lines of work will enable graduate students, if desired, to select their major and minor subjects in different but related fields. The institution is especially fitted to superintend graduate work in the various horticultural lines. Instruction is in large measure given through seminars and special reading courses connected with the investigations.

Residence at the graduate school at Riverside is considered as residence at the university, and all of the work required for master's or doctor's degree can be taken at this institution. Applicants whose undergraduate training is deficient, in the special fields elected, will be expected to secure such preparation at Berkeley or elsewhere. The degrees are granted from the University of California, and the requirements are the same as for students in residence at Berkeley.

The CHAIRMAN. Unless there is some other matter to come before the session, we will stand adjourned.

Whereupon, at 12.45 o'clock, the subsection adjourned.

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## SESSION OF SUBSECTION 7 OF SECTION III.[1]

RALEIGH HOTEL,
*Tuesday morning, January 4, 1916.*

Chairman, CHARLES J. BRAND.

The session was called to order at 9.30 o'clock by the chairman.

The following papers were presented:

The marketing of farm mortage loans, by C. W. Thompson.

Financing cooperative marketing associations, by W. H. Kerr.

Modern retail merchandising, by C. C. Parlin.

The development of a Market News Service, by Wells A. Sherman.

A practical market system for our large cities, by G. V. Branch.

Developing foreign markets for apples, by Clarence W. Moomaw.

The principles and practices of cooperation applied to citrus production and distribution, by G. Harold Powell.

### THE MARKETING OF FARM MORTGAGE LOANS.

By C. W. THOMPSON,

*Specialist in Rural Organization, United States Department of Agriculture.*

The aim of this paper is to indicate briefly some of the results obtained by the Office of Markets and Rural Organization, United States Department of Agriculture, from studies in the marketing of farm mortgage loans in the United States.

TABLE 1.—*Farm-mortgage loans—Average rates for interest and commission.*

| Geographic division and State. | Average interest rate. | Average annual commission.[2] | Interest plus commission. | Geographic division and State. | Average interest rate. | Average annual commission.[2] | Interest plus commission. |
|---|---|---|---|---|---|---|---|
| New England: | | | | East North Central: | | | |
| Maine | 6.1 | 0.1 | 6.2 | Ohio | 5.9 | 0.2 | 6.1 |
| New Hampshire | 5.3 | (3) | 5.3 | Indiana | 5.8 | .4 | 6.2 |
| Vermont | 5.6 | (3) | 5.6 | Illinois | 5.7 | .3 | 6.0 |
| Massachusetts | 5.6 | (3) | 5.6 | Michigan | 6.3 | .3 | 6.6 |
| Rhode Island | 5.7 | .2 | 5.9 | Wisconsin | 5.7 | .1 | 5.8 |
| Connecticut | 5.7 | (3) | 5.7 | West North Central: | | | |
| Middle Atlantic: | | | | Minnesota | 6.3 | 0.5 | 6.8 |
| New York | 5.5 | .1 | 5.6 | Iowa | 5.6 | .3 | 5.9 |
| New Jersey | 5.5 | .3 | 5.8 | Missouri | 6.2 | .6 | 6.8 |
| Pennsylvania | 5.5 | .3 | 5.8 | North Dakota | 6.9 | 1.8 | 8.7 |

[1] There was no stenographic report of this meeting.
[2] Where the report shows a commission paid once for all in advance on a loan running more than one year, the equivalent annual commission is used.
[3] Less than one-tenth of 1 per cent.



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TABLE 1.—*Farm-mortgage loans—Average rates for interest and commission*—Contd.

| Geographic division and State. | Average interest rate. | Average annual commission. | Interest plus commission. | Geographic division and State. | Average interest rate. | Average annual commission. | Interest plus commission. |
|---|---|---|---|---|---|---|---|
| West North Central—Continued. | | | | West South Central: | | | |
| South Dakota | 7.0 | 1.0 | 8.0 | Arkansas | 9.0 | 0.6 | 9.6 |
| Nebraska | 6.3 | .8 | 7.1 | Louisiana | 8.2 | .4 | 8.6 |
| Kansas | 6.1 | .8 | 6.9 | Oklahoma | 6.6 | 1.8 | 8.4 |
| South Atlantic: | | | | Texas | 8.4 | .6 | 9.0 |
| Delaware | 5.6 | (3) | 5.6 | Mountain: | | | |
| Maryland | 5.7 | .4 | 6.1 | Montana | 8.4 | 1.6 | 10.0 |
| Virginia | 6.1 | .7 | 6.8 | Idaho | 8.2 | .7 | 8.9 |
| West Virginia | 6.2 | .2 | 6.4 | Wyoming | 9.2 | .8 | 10.0 |
| North Carolina | 6.3 | 1.4 | 7.7 | Colorado | 8.3 | .6 | 8.9 |
| South Carolina | 7.8 | .6 | 8.4 | New Mexico | 9.7 | .8 | 10.5 |
| Georgia | 7.6 | 1.1 | 8.7 | Arizona | 9.1 | .3 | 9.4 |
| Florida | 9.0 | .6 | 9.6 | Utah | 8.6 | .4 | 9.0 |
| East South Central: | | | | Pacific: | | | |
| Kentucky | 6.7 | 0.4 | 7.1 | Washington | 7.9 | .8 | 8.7 |
| Tennessee | 7.3 | .6 | 7.9 | Oregon | 7.7 | .3 | 8.0 |
| Alabama | 8.7 | .7 | 9.4 | California | 7.4 | .2 | 7.6 |
| Mississippi | 8.0 | .5 | 8.5 | | | | |

The average costs for interest and commission on farm-mortgage loans, as revealed in these studies, are shown in Table 1. The commission figures shown in this table represent the average annual commission, or, where single advance commission is paid on a long-term loan, the equivalent annual commission. It will be seen that, in general, the average costs for interest and commission together are highest in the Southern and Rocky Mountain States, and that the lowest figures appear in the New England and Middle Atlantic States and the more highly developed agricultural sections of the corn belt. The average commissions are shown to be especially high in certain States, notably North Dakota, North Carolina, Oklahoma, and Montana.

Where commission is charged, it is collected either as a cash payment in advance (that is, it is taken out of the nominal amount loaned), or in a number of installments. Installment commission is usually collected annually or semi-annually, with the interest, but arrangements are frequently made for the payment of the whole commission on a five-year loan, say, in two or three annual installments.

TABLE 2.—*Percentage of farm-mortgage business on which commission is paid.*

| Geographic division and State. | Percentage without commission. | Percentage with commission. | | |
|---|---|---|---|---|
| | | Total. | With commission paid in advance. | With commission paid in installments. |
| New England: | | | | |
| Maine | 91.1 | 8.9 | 5.0 | 3.9 |
| New Hampshire | 96.6 | 3.4 | 3.4 | ..... |
| Vermont | 94.1 | 5.9 | 4.8 | 1.1 |
| Massachusetts | 97.2 | 2.8 | 2.7 | .1 |
| Rhode Island | 78.3 | 21.7 | 11.7 | 10.0 |
| Connecticut | 98.7 | 1.3 | 1.3 | ..... |
| Middle Atlantic: | | | | |
| New York | 86.6 | 13.4 | 9.6 | 3.8 |
| New Jersey | 72.3 | 27.7 | 18.7 | 9.0 |
| Pennsylvania | 81.4 | 18.6 | 10.1 | 8.5 |

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TABLE 2.—*Percentage of farm-mortgage business on which commission is paid*—Contd.

| Geographic division and State. | Percentage without commission. | Percentage with commission. | | |
|---|---|---|---|---|
| | | Total. | With commission paid in advance. | With commission paid in installments. |
| **East North Central:** | | | | |
| Ohio | 73.7 | 26.3 | 17.9 | 8.4 |
| Indiana | 54.5 | 45.5 | 36.2 | 9.3 |
| Illinois | 52.7 | 47.3 | 39.1 | 8.2 |
| Michigan | 76.8 | 23.2 | 18.0 | 5.2 |
| Wisconsin | 85.1 | 14.9 | 10.4 | 4.5 |
| **West North Central:** | | | | |
| Minnesota | 52.3 | 47.7 | 20.0 | 27.7 |
| Iowa | 36.0 | 64.0 | 51.3 | 12.7 |
| Missouri | 45.1 | 54.9 | 28.0 | 26.9 |
| North Dakota | 20.2 | 79.8 | 17.0 | 62.8 |
| South Dakota | 31.8 | 68.2 | 45.5 | 22.7 |
| Nebraska | 30.7 | 69.3 | 53.5 | 15.8 |
| Kansas | 32.2 | 67.8 | 30.6 | 37.2 |
| **South Atlantic:** | | | | |
| Delaware | 98.1 | 1.9 | 1.9 | ..... |
| Maryland | 64.3 | 35.7 | 28.5 | 7.2 |
| Virginia | 65.9 | 34.1 | 26.2 | 7.9 |
| West Virginia | 88.9 | 11.1 | 8.8 | 2.3 |
| North Carolina | 59.1 | 40.9 | 27.5 | 13.4 |
| South Carolina | 64.7 | 35.3 | 26.0 | 9.3 |
| Georgia | 33.9 | 66.1 | 54.1 | 12.0 |
| Florida | 70.2 | 29.8 | 18.6 | 11.2 |
| **East South Central:** | | | | |
| Kentucky | 76.7 | 23.3 | 14.2 | 9.1 |
| Tennessee | 64.6 | 35.4 | 23.9 | 11.5 |
| Alabama | 62.8 | 37.2 | 25.2 | 12.0 |
| Mississippi | 74.5 | 25.5 | 15.7 | 9.8 |
| **West South Central:** | | | | |
| Arkansas | 66.9 | 33.1 | 18.6 | 14.5 |
| Louisiana | 76.8 | 23.2 | 16.3 | 6.9 |
| Oklahoma | 8.4 | 91.6 | 36.7 | 54.9 |
| Texas | 57.0 | 43.0 | 27.1 | 15.9 |
| **Mountain:** | | | | |
| Montana | 31.1 | 68.9 | 28.4 | 40.5 |
| Idaho | 35.8 | 64.2 | 45.6 | 18.6 |
| Wyoming | 59.9 | 40.1 | 28.1 | 12.0 |
| Colorado | 41.7 | 58.3 | 47.0 | 11.3 |
| New Mexico | 59.0 | 41.0 | 32.8 | 8.2 |
| Arizona | 80.5 | 19.5 | 9.5 | 10.0 |
| Utah | 67.0 | 33.0 | 18.3 | 14.7 |
| **Pacific:** | | | | |
| Washington | 41.8 | 58.2 | 46.4 | 11.8 |
| Oregon | 68.4 | 31.6 | 23.6 | 8.0 |
| California | 81.0 | 19.0 | 15.1 | 3.9 |

Table 2 reflects the relative importance of farm-mortgage loans with no commission, advance commission, and annual commission in each State, as indicated by these studies. It will be noticed that in those States where the margin charged for commission is relatively high, for example, North Dakota, Oklahoma, and Montana, the percentage of loans on which commission is charged is also relatively high. Obviously, the general average for commission is affected both by the amount of the commission, where this is charged, as well as by the relative number of loans which pay commission.

There is a fairly definite relation between the proportion of the farm-mortgage loans in a given State which are made with commission and without commission, and the important sources from which funds are obtained for such loans. Broadly speaking, the no-commission loans represent that part of the farm-mortgage loans made from local capital. To the extent, therefore, that the farm-mortgage loans made by banks indicate the relative amount of local capital thus invested, one may expect to find some degree of correlation be-

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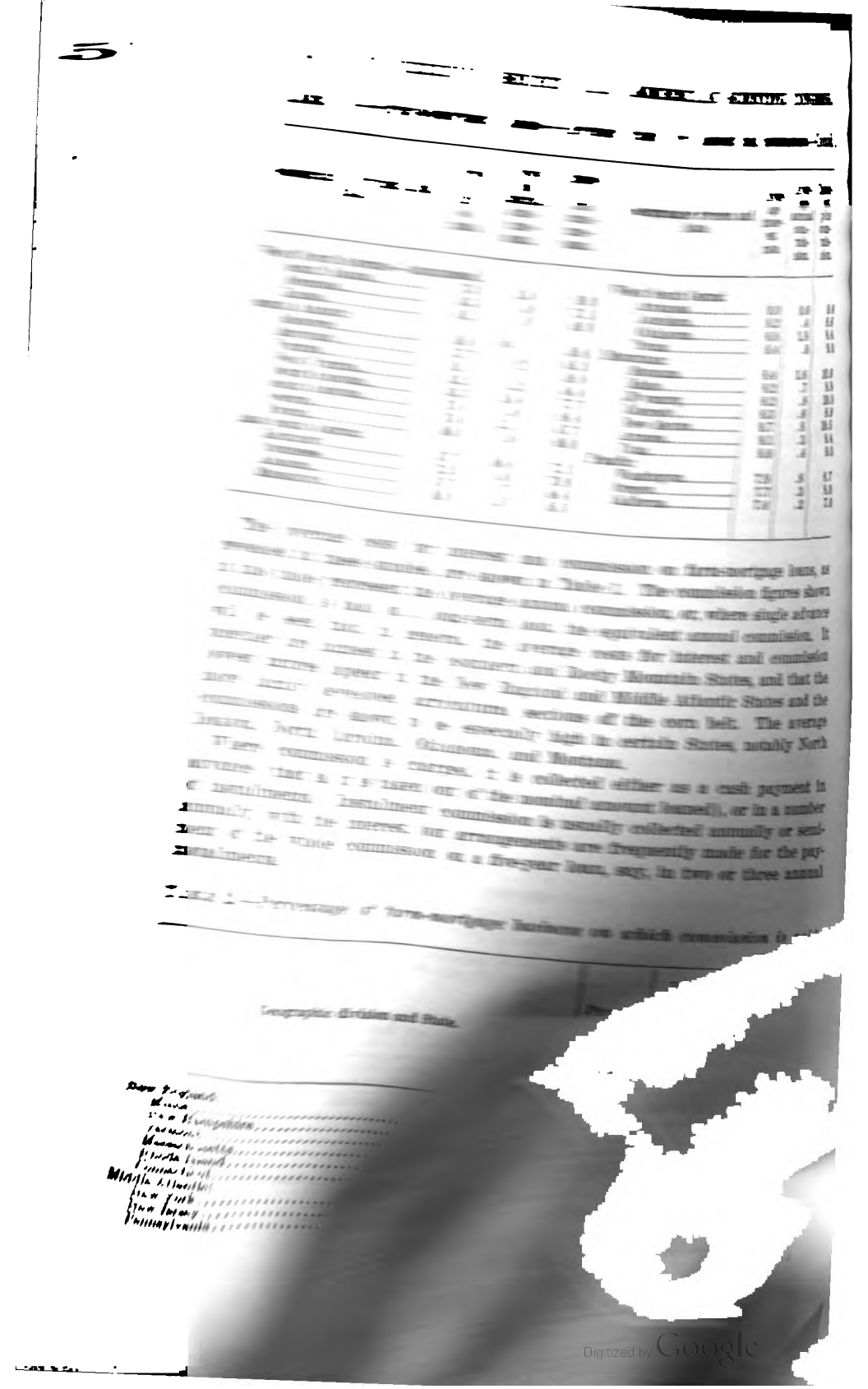

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TABLE 2.—*Percentage of farm-mortgage business on which commission is paid*—Contd.

| Geographic division and State. | Percentage without commission. | Percentage with commission. | | |
|---|---|---|---|---|
| | | Total. | With commission paid in advance. | With commission paid in installments. |
| **East North Central:** | | | | |
| Ohio | 73.7 | 26.3 | 17.9 | 5.4 |
| Indiana | 54.5 | 45.5 | 26.2 | 9.3 |
| Illinois | 52.7 | 47.3 | 28.1 | 5.2 |
| Michigan | 76.8 | 23.2 | 15.0 | 2.3 |
| Wisconsin | 85.1 | 14.9 | 10.4 | 4.5 |
| **West North Central:** | | | | |
| Minnesota | 52.3 | 47.7 | 28.9 | [illegible] |
| Iowa | 36.0 | 64.0 | 51.3 | [illegible] |
| Missouri | 45.1 | 54.9 | 28.1 | [illegible] |
| North Dakota | 20.2 | 79.8 | 17.1 | [illegible] |
| South Dakota | 31.8 | 68.2 | 45.1 | [illegible] |
| Nebraska | 30.7 | 69.3 | 52.5 | [illegible] |
| Kansas | 32.2 | 67.8 | 31.4 | [illegible] |
| **South Atlantic:** | | | | |
| Delaware | 98.1 | 1.9 | [illegible] | ---------- |
| Maryland | 64.3 | 35.7 | [illegible] | [illegible] |
| Virginia | 65.9 | 34.1 | [illegible] | [illegible] |
| West Virginia | 88.9 | 11.1 | [illegible] | [illegible] |
| North Carolina | 59.1 | 40.9 | [illegible] | [illegible] |
| South Carolina | 64.7 | 35.3 | [illegible] | [illegible] |
| Georgia | 22.9 | [illegible] | [illegible] | [illegible] |
| Florida | 70.2 | [illegible] | [illegible] | [illegible] |
| **East South Central:** | | | | |
| Kentucky | 76.7 | [illegible] | [illegible] | [illegible] |
| Tennessee | 64.6 | [illegible] | [illegible] | [illegible] |
| Alabama | 62.8 | [illegible] | [illegible] | [illegible] |
| Mississippi | 74.5 | [illegible] | [illegible] | [illegible] |
| **West South Central:** | | | | |
| Arkansas | 66.9 | [illegible] | [illegible] | [illegible] |
| Louisiana | 76.8 | [illegible] | [illegible] | [illegible] |
| Oklahoma | 8.6 | [illegible] | [illegible] | [illegible] |
| Texas | [illegible] | [illegible] | [illegible] | [illegible] |
| **Mountain:** | | | | |
| Montana | [illegible] | [illegible] | [illegible] | [illegible] |
| Idaho | [illegible] | [illegible] | [illegible] | [illegible] |
| Wyoming | [illegible] | [illegible] | [illegible] | [illegible] |
| Colorado | [illegible] | [illegible] | [illegible] | [illegible] |
| New Mexico | [illegible] | [illegible] | [illegible] | [illegible] |
| Arizona | [illegible] | [illegible] | [illegible] | [illegible] |
| Utah | [illegible] | [illegible] | [illegible] | [illegible] |
| **Pacific:** | | | | |
| Washington | [illegible] | [illegible] | [illegible] | [illegible] |
| Oregon | [illegible] | [illegible] | [illegible] | [illegible] |
| California | [illegible] | [illegible] | [illegible] | [illegible] |

Table 2 reflect[illegible]tive importance of [illegible] commission, ad[illegible]ission, and [illegible] indicated by [illegible] It will [illegible] margin [illegible]ission is [illegible], the p[illegible] ely high[illegible] by the a[illegible] tive nu[illegible] definit[illegible] ven St[illegible] impo[illegible] spe[illegible] los[illegible] ctra[illegible] fu[illegible]

| | | | | |
|---|---|---|---|---|
| | | | | 2,580 |
| | | | | 840 |
| | | | | 750 |
| | | | | 540 |
| | | | 27.1 | 1,250 |
| | | | 42.6 | 2,610 |
| | | | 2.9 | 6,550 |
| | | | 6.0 | 8,340 |
| | | 5,200 | 30.4 | 7,850 |
| | | 2,200 | 10.2 | 4,980 |
| | | 1,200 | 16.8 | 830 |
| | | 2,100 | 5.7 | 1,740 |
| | 0 | 400 | 8.7 | 390 |
| | 3.0 | 1,600 | 38.5 | 1,070 |
| | 12.6 | 6,000 | 88.0 | 340 |
| | .5 | 1,100 | 35.2 | 100 |
| [illegible]37 | 7.1 | 5,000 | 11.5 | 11,110 |
| [illegible],091 | 3.1 | 4,100 | 11.5 | 2,910 |
| 10,047 | 8.1 | 56,100 | 45.0 | 3,760 |

[illegible]ith assets representing more than 99 per cent of the total [illegible]he country.

[illegible]ficials as agents or correspondents for other investors.

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tween the proportion of the farm-mortgage loans made without commission and the proportion of the total amount of farm mortgages held by the local banks. In Arkansas, for example, where our figures show that more than one-fourth of the total farm-mortgage loans are made by banks, 67 per cent of the farm-mortgage business is done without commission, while in Oklahoma, where the farm mortgages held by local banks represent only 3 per cent of the estimated total outstanding, less than 9 per cent of the business is done without commission.

Again, we find that the States deriving a large percentage of their farm-mortgage funds from insurance companies are among those where commission is paid on a relatively large proportion of the farm-mortgage loans. This condition follows naturally from the fact that wherever capital for mortgage loans is obtained from outside sources, especially from distant sources, it generally passes through the hands of one or more middlemen, to whom commissions must be paid. Insurance companies, of course, represent only one of several "outside" sources from which capital for farm-mortgage loans is secured, but they are of sufficient importance in a number of States to make it of interest to compare the proportion of the total farm-mortgage capital which they furnish with the proportion of farm-mortgage business on which commission is charged. For example, in Georgia, Nebraska, Oklahoma, Kansas, South Dakota, and Iowa, which are among the States obtaining the largest proportion of their farm-mortgage capital from insurance companies, the percentage of farm-mortgage business on which commission is charged ranges from 64 (in Iowa) to 92 (in Oklahoma). On the other hand, in States like Michigan and Wisconsin, where farm mortgages held by insurance companies represent less than 2 per cent of the estimated total farm-mortgage debt, the proportion of the farm-mortgage business on which commission is paid is much less; and those Eastern States where the insurance companies do practically no farm-mortgage loan business are among those having the lowest percentage of commission loans.

We may conclude, therefore, that the practice of charging commissions is most widely current in States where it is necessary to draw on outside capital for considerable amounts; and that, on the other hand, in States where local capital is in the main sufficient for farm-mortgage loan purposes, a large proportion of the loans are made without the payment of any commission.

This suggests the importance of examining carefully the sources of capital available for farm-mortgage loans in the various States. Let us first note how far the banks supply capital from their own funds for this purpose. Banks appear to furnish approximately $740,000,000, or more than one-fifth of the total amount invested in farm mortgages in the United States.

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TABLE 3.—*Quantitative data relative to farm-mortgage loans.*

[Figures for amounts represent thousands of dollars.]

| Geographic division and State. | Estimated total farm-mortgage debt.[1] | Farm mortgages held by life insurance companies.[2] | | Farm mortgages held by banks.[3] | | Farm mortgages "handled" by banks.[4] |
|---|---|---|---|---|---|---|
| | | Amount. | Per cent of estimated total. | Amount. | Per cent of estimated total. | |
| United States | 3,596,985 | 693,940 | 19.3 | 739,500 | 20.6 | 486,580 |
| **Geographic divisions:** | | | | | | |
| New England | 80,544 | 106 | .1 | 84,900 | 105.4 | 10 |
| Middle Atlantic | 313,150 | 556 | .2 | 30,900 | 9.9 | 2,040 |
| East North Central | 944,436 | 121,075 | 12.8 | 220,000 | 23.3 | 123,360 |
| West North Central | 1,375,903 | 426,960 | 31.0 | 216,400 | 15.7 | 282,710 |
| South Atlantic | 153,155 | 22,930 | 15.0 | 40,800 | 26.6 | 19,920 |
| East South Central | 127,135 | 22,871 | 18.0 | 33,600 | 26.4 | 4,710 |
| West South Central | 299,614 | 72,685 | 24.3 | 27,900 | 9.3 | 18,750 |
| Mountain | 101,285 | 12,532 | 12.4 | 19,800 | 19.5 | 17,300 |
| Pacific | 203,757 | 14,225 | 7.0 | 65,200 | 32.0 | 17,780 |
| **New England:** | | | | | | |
| Maine | 13,727 | 15 | .1 | 6,000 | 43.7 | ..... |
| New Hampshire | 6,100 | ..... | ..... | 12,500 | 204.9 | ..... |
| Vermont | 17,113 | 13 | .1 | 46,700 | 272.9 | ..... |
| Massachusetts | 24,077 | 9 | (5) | 8,700 | 36.2 | 10 |
| Rhode Island | 2,514 | ..... | ..... | 6,000 | 238.7 | ..... |
| Connecticut | 17,013 | 69 | .4 | 5,000 | 29.4 | ..... |
| **Middle Atlantic:** | | | | | | |
| New York | 168,234 | 128 | .1 | 18,200 | 10.8 | 1,150 |
| New Jersey | 35,610 | 222 | .6 | 2,600 | 7.3 | 30 |
| Pennsylvania | 109,312 | 206 | .2 | 10,100 | 9.2 | 860 |
| **East North Central:** | | | | | | |
| Ohio | 130,678 | 17,073 | 13.1 | 26,200 | 20.1 | 1,360 |
| Indiana | 132,325 | 48,789 | 36.9 | 52,000 | 39.3 | 14,590 |
| Illinois | 355,802 | 51,046 | 14.3 | 56,200 | 15.8 | 87,530 |
| Michigan | 118,950 | 1,706 | 1.4 | 44,900 | 37.8 | 6,640 |
| Wisconsin | 206,681 | 2,461 | 1.2 | 40,700 | 19.7 | 13,240 |
| **West North Central:** | | | | | | |
| Minnesota | 145,181 | 35,577 | 24.5 | 43,600 | 30.0 | 43,020 |
| Iowa | 469,063 | 150,150 | 32.0 | 104,800 | 22.3 | 70,230 |
| Missouri | 223,107 | 59,699 | 26.8 | 34,900 | 15.6 | 31,170 |
| North Dakota | 100,364 | 19,423 | 19.4 | 5,000 | 5.0 | 42,370 |
| South Dakota | 92,467 | 31,024 | 33.6 | 6,200 | 6.7 | 43,190 |
| Nebraska | 165,015 | 66,614 | 40.4 | 10,400 | 6.3 | 19,580 |
| Kansas | 180,706 | 64,473 | 35.7 | 11,500 | 6.4 | 33,150 |
| **South Atlantic:** | | | | | | |
| Delaware | 6,857 | 46 | .7 | 1,600 | 23.3 | ..... |
| Maryland | 32,393 | 492 | 1.5 | 6,000 | 18.5 | 310 |
| Virginia | 25,007 | 670 | 2.7 | 5,000 | 20.9 | 570 |
| West Virginia | 8,725 | 23 | .3 | 1,700 | 19.5 | 30 |
| North Carolina | 21,005 | 2,267 | 10.8 | 6,900 | 32.9 | 2,200 |
| South Carolina | 24,967 | 3,884 | 15.6 | 9,000 | 36.1 | 3,180 |
| Georgia | 29,711 | 15,479 | 52.1 | 8,000 | 26.9 | 12,280 |
| Florida | 4,490 | 69 | 1.5 | 2,600 | 57.9 | 1,350 |
| **East South Central:** | | | | | | |
| Kentucky | 41,305 | 7,170 | 17.4 | 13,300 | 32.2 | 2,580 |
| Tennessee | 25,468 | 10,674 | 41.9 | 4,000 | 15.7 | 840 |
| Alabama | 25,943 | 1,771 | 6.8 | 3,700 | 14.3 | 750 |
| Mississippi | 34,419 | 3,256 | 9.5 | 12,600 | 36.6 | 540 |
| **West South Central:** | | | | | | |
| Arkansas | 21,023 | 4,259 | 20.3 | 5,700 | 27.1 | 1,250 |
| Louisiana | 21,141 | 1,500 | 7.1 | 9,000 | 42.6 | 2,610 |
| Oklahoma | 73,129 | 29,065 | 39.7 | 2,100 | 2.9 | 6,550 |
| Texas | 184,321 | 37,861 | 20.5 | 11,100 | 6.0 | 8,340 |
| **Mountain:** | | | | | | |
| Montana | 17,111 | 3,518 | 20.6 | 5,200 | 30.4 | 7,850 |
| Idaho | 21,566 | 2,948 | 13.7 | 2,200 | 10.2 | 4,980 |
| Wyoming | 7,148 | 487 | 6.8 | 1,200 | 16.8 | 830 |
| Colorado | 36,767 | 3,135 | 8.5 | 2,100 | 5.7 | 1,740 |
| New Mexico | 4,585 | 1,191 | 26.0 | 400 | 8.7 | 390 |
| Arizona | 4,161 | 376 | 9.0 | 1,600 | 38.5 | 1,070 |
| Utah | 6,818 | 862 | 12.6 | 6,000 | 88.0 | 340 |
| Nevada | 3,129 | 15 | .5 | 1,100 | 35.2 | 100 |
| **Pacific:** | | | | | | |
| Washington | 43,470 | 3,087 | 7.1 | 5,000 | 11.5 | 11,110 |
| Oregon | 35,535 | 1,091 | 3.1 | 4,100 | 11.5 | 2,910 |
| California | 124,752 | 10,047 | 8.1 | 56,100 | 45.0 | 3,760 |

[1] Estimates based on Thirteenth Census figures.

[2] Figures actually reported by 220 companies, with assets representing more than 99 per cent of the total admitted assets of all life insurance companies in the country.

[3] Estimates based on reports received from banks.

[4] Farm mortgages negotiated by banks or bank officials as agents or correspondents for other investors. Estimates based on reports received from banks.

[5] Less than one-tenth of 1 per cent.

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Table 3 shows the relative importance of the farm mortgages held by the banks of each State. In California the farm mortgages held by banks represent 45 per cent of the estimated total farm-mortgage debt; in Louisiana, 43 per cent; in Indiana and Michigan, nearly 40 per cent; and in Mississippi and South Carolina, more than 36 per cent.

So far as the bank funds in any State invested in farm mortgages represent local farm-mortgage capital there is the advantage of first-hand contact with borrowers enabling the investor to see that the security is properly cared for during the term of the loan. In certain sections, such as in the New England and the Middle Atlantic States, where it is customary for banks to place loans in other States, the banks do not have this advantage, but must operate through other agencies in the placing of their loans.

The relative importance of farm-mortgage loans from different classes of banks may also be noted. In Iowa, where we find 56 per cent of the total number of the stock savings banks of the United States, this class of banks supplies more than two-thirds of the total capital from all banks in that State. Likewise, in California the savings banks furnish even a larger proportion of the total capital invested by all banks. On the other hand, in such a State as Minnesota, where there are few savings banks, the farm-mortgage loans held by State and private banks and trust companies constitute about 95 per cent of the total capital furnished by all banks in that State.

The importance of life insurance companies as sources of capital for farm-mortgage loans in the various States is also shown in Table 3. It is seen that these insurance companies supply approximately $700,000,000 for farm-mortgage loan purposes, or about one-fifth of the total farm-mortgage capital of the United States. Practically one-half of the insurance money is invested in the four States of Iowa, Missouri, Kansas, and Nebraska. Iowa alone holds nearly 22 per cent of the total amount of insurance money invested in farm mortgages. In few of the Southern and Rocky Mountain States do the insurance funds invested in farm mortgages represent more than one-half of 1 per cent of the total farm-mortgage capital obtained from this source.

The life insurance companies either have their own farm mortgage departments, through which they receive and pass on applications for loans, or they purchase farm mortgages outright in the commercial market. The latter practice is generally limited to the smaller insurance companies, the volume of whose business in this field is not sufficient to warrant their establishing separate machinery for the selection of farm mortgage securities.

On the other hand, the larger insurance companies which invest considerable funds in farm mortgages have very well organized departments through which they carry on a regular farm-mortgage loan business. They usually limit their loans to territory such as they can approve for this purpose, and hire salaried appraisers, whose inspection of any given individual loan is required before the loan is finally accepted. Ordinarily, these companies receive applications through local agencies or correspondents, usually local banks. The application blanks and legal papers used by these insurance companies, including mortgages and notes, have been carefully standardized and adapted to the conditions in the various States where loans are made. While some of the companies show a tendency to make loans at relatively high rates, insurance companies more often represent a highly conservative class of investors in the farm mortgage loan business. Their advent into any given State for investment purposes usually leads to a lowering of charges on farm mortgages. Local investors are often governed in their charges by the practices of competing insurance companies.

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Figures are not at hand to show the amount of capital invested in farm mortgage loans by mortgage companies. These companies figure prominently in the farm mortgage business in all parts of the country, however, and include a number of foreign companies which have invested heavily in farm mortgages in the West South Central, Rocky Mountain, and Pacific States.

There are a number of domestic mortgage companies which have confined their attention to a conservative loan business and have established a reputation for a relatively safe class of investment loans. This has enabled them to build up a clientele of investors, with connections of long standing. Other mortgage companies prefer to handle mortgage loans commanding relatively high rates and commissions. Among the latter are those mortgage companies which limit their business to second mortgages, and receive the extreme figures for both commission and interest.

Mortgage companies may also be classified with reference to the extent of the territory in which they do business. Thus there are those that cover a relatively large territory, including many States, while other companies limit their business to a more restricted area, often a single State or a part of a State. In either case the loans are usually placed through local agents or correspondents, although it is the practice among many of the smaller companies to make loans direct to farmers also. A mortgage company may buy the mortgage and reassign it to another purchaser, or it may have the paper made out to itself in the first instance, to be resold later. In either case the mortgage company collects a commission in addition to that received by the local agent or correspondent.

In addition to the funds supplied for farm-mortgage loans by insurance companies, banks, and mortgage companies, approximately $25,000,000 is being loaned from school or land grant funds directly to farmers in certain States, such as Oregon, South Dakota, Oklahoma, Iowa, Idaho, North Dakota, Utah, and Indiana. The interest charge on these loans is usually 5 or 6 per cent. In Idaho the rate actually charged is 7 per cent. These loans are handled directly from the state departments in Utah, Idaho, North and South Dakota, Oklahoma, and Oregon; in Iowa and Indiana, however, the loans are handled through the counties, which are held responsible for all losses on account of insufficient security or through defalcations by county officers.

No figures are available to show the amount of farm-mortgage capital supplied by private investors. It is clear, however, that in certain States, such as New York, Pennsylvania, Michigan, and Wisconsin, the amount of capital supplied by private investors is relatively large.

Besides furnishing capital for farm mortgage loans from their own funds, banks and mortgage companies act as intermediaries or middlemen, purchasing or negotiating large amounts of farm mortgages for insurance companies and other outside investors. Thus, in North Dakota, the banks negotiate about $40,000,000 a year in loans for other investors, whereas the amount invested in farm mortgages from their own funds is only one-eighth of this sum. Similarly, in Nebraska the amount handled by banks is more than three times the amount of bank capital invested in farm mortgages. In most of the States west of the Mississippi River, the banks engage rather extensively in the business of handling farm mortgages for other investors.

Having considered the leading agencies through which mortgage capital is rendered available to farmers, as well as the usual costs for interest and commission, let us note briefly the important factors which influence the terms on which the farmer obtains mortgage loans. Climatic conditions are impor-

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tant because of their effect on the value of the farm security. The semiarid regions of the Western States do not attract capital as freely as the farming sections farther east, where rain is relatively abundant. Important sources of capital, including insurance companies and savings banks, often refuse to loan money on farm mortgage security where the average rainfall is below a certain figure. It is still uncertain how far the results of dry-farming methods will be able to overcome the diffidence of conservative investors with reference to loans in semiarid territory.

The character of the soil is also considered by farm-mortgage investors. Capital does not flow as freely to southern Illinois as to other parts of that State, partly because of differences in soil conditions. The Red River Valley of the North, in the northern part of Minnesota and North Dakota, attracts capital freely at relatively low rates of interest largely because its soil and climate render the income from prevailing types of farming relatively certain. Similar illustrations of the effect of soil and climate on the flow of farm-mortgage capital could be given for other parts of the country.

No factor, however, is given greater consideration by farm mortgage investors in determining their attitude toward loans in a given area than the prevailing method of farming. The careful investor in farm mortgages considers all the known factors affecting the income of the farm offered as a security. He studies the relation of the farm income to the price of the land to determine whether the farm value is on a speculative or an investment basis. He is interested in the degree of regularity in income from year to year and therefore tries to ascertain what crops or products are raised and how far these are adapted to the given conditions. He knows of the extra hazards involved in one-crop farming and therefore inquires about tendencies in the direction of diversified agriculture. He even inquires into the business habits of the farm owners and the kind of care given to the farm products. It is necessary, in general, to understand the importance of differences along all these lines in order to explain the variation in the costs of farm-mortgage loans to borrowers in a given locality.

There are factors outside of the farm itself, however, which must also be considered in this connection and which help to explain the variation in charges as between different localities or different States. The distance from financial centers affects the charges. In studying the average interest rates for the different States one notices the gradual rise in costs as one moves outward from the leading financial centers.

The character of the financial agencies through which farm-mortgage capital reaches the farmer is also of great importance. One needs to consider the part played by agencies that render local savings available for this purpose as well as the kind of facilities through which outside capital reaches the farmers of any given locality. Where local savings institutions have been well developed, as in Iowa or California, the effect on available local capital for farm-loan purposes is readily discerned. On the other hand, the result of a general lack of suitable local savings institutions, as shown especially in many regions of the South and West, is likewise apparent.

The practice of drawing on outside capital for farm-mortgage loan purposes is found, as we have seen, both in the most highly developed agricultural sections of the corn belt and in the relatively less developed agricultural regions of the South and West. The general need for suitable facilities through which outside capital may reach the farmers in different parts of the country is therefore clear. In the United States it is a fairly well established practice for country banks or real estate firms to act as local agents or correspondents for

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outside or distant investors, either direct or through other middlemen. It is also the usual practice to market the farmer's mortgage note in its original form. This makes it necessary to find a purchaser who wants a mortgage of a given amount, running for a given time, and with given terms. Obviously, paper of this character will not sell as readily in the open market as standardized securities. Distant investors are not generally in a position to have first-hand knowledge of the farm security underlying a given mortgage note. Moreover, they often prefer securities running in even amounts for uniform periods of time and with a convenient means of collecting the interest. Investors often prefer to be relieved of all concern as to the keeping up of the underlying security.

All these advantages are secured where the mortgage notes instead of being marketed direct are held as a collateral trust fund, and bond issues based thereon are placed on the market. To meet these requirements, however, institutions are needed both to fix reliable and suitable standards for farm-mortgage loans and to market them in the form of bonds. Such institutions can not be properly established without suitable safeguards. It is necessary to profit by the lessons of past American experience and avoid the mistakes made by the debenture institutions in this country in the eighties and early nineties. The almost complete failure of the farm-mortgage-debenture business in 1893 affords ample warning. We need to take stock of all the factors that contributed to that failure. The granting of loans out of proportion to protection funds, the failure to build up adequate reserves, the basing of loans on boom estimates of land values, the extension of loans on lands of uncertain returns, the substitution of inferior for standard collateral securities, the utter lack of inspection and supervision under State or Federal law—these practices quite naturally led to disaster. As a result there was an almost complete collapse of these early debenture companies.

In order to establish institutions through which farm mortgages may be properly selected, according to reliable and suitable standards, and through which such mortgage loans may be converted into acceptable securities for the open market, it is clearly necessary to have legislation, both by the individual States and by the Federal Congress. The mortgage paper of any State can not be properly standardized without suitable State legislation governing the validity of land titles and the method of foreclosure. Farm-mortgage capital will not flow into a State whose taxation laws render the investment of farm-mortgage capital in other regions more profitable. Every State needs to husband carefully its resources of investment capital by providing suitable legislation for the creation of local savings institutions, as well as associations among borrowers for credit improvement.

At the same time it seems clear that if the farmers are to obtain adequate connections with the outside capital of the open-investment market, connections often involving wide areas reaching across many States, the problem involved is one too large to be solved by legislation on the part of any individual State. Moreover, a degree of uniformity in supervision and control is needed, which it is doubtful whether State legislation would supply. So far, therefore, as the problem is one of legislation to provide suitable institutions to connect the farmer with the open-investment market, Federal legislation seems clearly needed.

Being given a properly organized credit system, it is believed that the farmer who adopts business methods in his farming and thus shows himself worthy of credit will have adequate opportunity to secure it on reasonable terms. The farmers' need in connection with mortgage credit is to obtain investment capital



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for relatively long periods of time, on suitable terms of repayment, and at the lowest cost consistent with business policy. A properly organized system should supply this need, and, under suitable Federal regulation and control, should protect the farmer against the unreasonable charges now prevailing in many localities.

## FINANCING COOPERATIVE MARKETING ASSOCIATIONS.

By W. H. KERR,

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The material for this paper was secured by a special survey made of some 700 typical farmers and cooperative marketing organizations in the United States. This survey was carried on by the writer in his official capacity as a member of the staff of the Office of Markets and Rural Organization. Considerable of the information was secured by personal visits to organizations throughout the country and interviews with bankers and others during the year 1914 in securing data for an article on this subject.[1]

Particular attention has been paid to grain elevators, creameries, cheese factories, and fruit and produce associations, these classes being most important both as to number and the amount of business transacted. An estimate based upon data obtained by the Office of Markets and Rural Organization from a survey of cooperative marketing in this country, shows that there are over 3,300 farmers' and cooperative grain elevators, and some 3,000 farmers and cooperative creameries and cheese factories, about 1,500 fruit and produce organizations, and approximately 1,700 cotton warehouses, gins, canneries, and other miscellaneous marketing organizations, or a total of some 9,500.

Table I shows the amount of business transacted by 1,743 of these organizations in 1913. From this some idea of the enormous amount of agricultural products marketed by these 9,500 organizations may be had.

The problems relating to the financing of grain elevators, creameries, and cheese factories, and fruit and produce organizations are deemed more acute than those of the other cooperative marketing agencies. Therefore this paper will be limited to an extent to a discussion of these concerns.

TABLE No. 1.—*Total business transacted by 1,743 farmers' marketing organizations in 1913, shown by classes, with average business for each class.*

| Kind of business. | Number reporting. | Total business. | Average. |
|---|---|---|---|
| Grain elevators | 736 | $97,837,779 | $132,982 |
| Creameries and cheese factories | 688 | 32,440,975 | 47,298 |
| Fruit and produce associations | 319 | 75,456,265 | 236,540 |
| Total | 1,743 | 205,735,019 | ..... |

[1] Cooperative Marketing and Financing of Marketing Associations, by C. E. Bassett, Clarence W. Moomaw, and W. H. Kerr, Yearbook Separate 637, United States Department of Agriculture.

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TABLE NO. 2.—*Summary of the reports of 653 farmers' marketing organizations, showing business transacted 1914 and 1915, value of buildings and equipment, and value of assets in excess of liabilities.*

| Kind of business. | Number reporting. | Paid-up capital of membership. | | Business transacted. | | | | | | Value of buildings and equipment. | | | Value of assets in excess of liabilities.[1] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total. | Average. | 1914 | | | 1915 | | | Number reporting. | Amount. | Average. | Number reporting. | Amount. | Average. |
| | | | | Number reporting. | Amount. | Average. | Number reporting. | Amount. | Average. | | | | | | |
| Grain elevators | 328 | $2,553,463 | $7,785 | 326 | $57,793,810 | $177,282 | 307 | $55,303,133 | $180,140 | 326 | $2,857,555 | $8,765 | 328 | $4,361,875 | $13,298 |
| Creameries and cheese factories | 172 | 716,996 | 4,169 | 172 | 9,758,881 | 56,738 | 167 | 10,812,302 | 64,744 | 174 | 1,199,424 | 6,893 | 173 | 1,003,339 | 6,320 |
| Fruit and produce | 84 | 1,672,311 | 19,908 | 90 | 42,114,758 | 467,932 | 81 | 42,945,055 | 530,223 | 76 | 993,215 | 13,069 | 91 | 2,411,318 | 26,499 |
| Cotton warehouses and gins | 26 | 179,778 | 6,915 | 26 | 1,137,046 | 43,732 | 23 | 1,018,450 | 44,280 | 27 | 204,772 | 7,584 | 26 | 321,146 | 12,351 |
| Miscellaneous | 43 | 456,057 | 10,606 | 40 | 2,385,869 | 59,647 | 41 | 2,542,793 | 62,019 | 35 | 205,792 | 5,885 | 42 | 740,675 | 17,635 |
| Grand total | 653 | 5,578,605 | 8,543 | 654 | 113,190,364 | 173,074 | 619 | 112,624,733 | 181,946 | 638 | 5,460,758 | 8,559 | 660 | 8,928,353 | 13,528 |

[1] Paid-up capital stock and membership fees not taken into account as liability.

NOTE.—The averages shown in this table are somewhat higher than those of Table 1, due to the fact that most of the large organizations are included in this table, while in Table 1 the number reporting is much larger and includes many of the small businesses.

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TABLE 3.—*Showing by classes the amounts borrowed and sources from which obtained.*

[Compiled from reports of 401 farmers' and cooperative marketing associations.]

| Kind of organization. | Number reporting. | Amount borrowed from bank. | | Number reporting but not giving amount borrowed from bank. | Number reporting. | Amount borrowed from commission firms. | | Number reporting but not giving amount borrowed from commission firms. | Number reporting. | Amount borrowed from individuals. | | Number reporting but not giving amount borrowed from individuals. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total. | Average. | | | Total. | Average. | | | Total. | Average. | |
| Elevators | 154 | $1,040,950 | $6,759 | 16 | 47 | $722,813 | $15,379 | 17 | 10 | $36,500 | $3,650 | 2 |
| Creameries and cheese factories | 26 | 56,650 | 2,179 | 4 | ..... | ..... | ..... | ..... | 2 | 4,000 | 2,000 | ..... |
| Fruit and produce | 63 | 1,115,275 | 17,703 | 3 | ..... | ..... | ..... | ..... | 1 | 1,500 | 1,500 | ..... |
| Cotton warehouses and gins | 10 | 65,750 | 6,575 | 2 | 1 | 500 | 500 | ..... | ..... | ..... | ..... | ..... |
| Tobacco | 2 | 85,000 | 42,500 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Miscellaneous | 13 | 39,900 | 3,069 | 1 | ..... | ..... | ..... | ..... | 5 | 125,700 | 25,140 | 3 |
| Grand total | 268 | 2,403,525 | 8,968 | 26 | 48 | 723,313 | 15,069 | 17 | 18 | 167,700 | 9,317 | 5 |

| Kind of organization. | Number reporting. | Amount borrowed from banks and commission firms. | | Number reporting but not giving amount borrowed from banks and commission firms. | Number reporting. | Amount borrowed from banks and individuals. | | Number reporting but not giving amount borrowed from banks and individuals. | Number reporting. | Amount borrowed from commission firms and individuals. | | Total number reporting. | Number reporting amount borrowed. | Total amount borrowed. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total. | Average. | | | Total. | Average. | | | Total. | Average. | | | Total. | Average. |
| Elevators | 17 | $218,200 | $12,835 | 1 | 33 | $296,500 | $8,985 | ..... | 1 | $20,000 | $20,000 | 298 | 262 | $2,334,963 | $8,912 |
| Creameries and cheese factories | ..... | ..... | ..... | ..... | 1 | 6,000 | 6,000 | ..... | ..... | ..... | ..... | 33 | 29 | 66,650 | 2,298 |
| Fruit and produce | ..... | ..... | ..... | ..... | 8 | 2,116,155 | 264,519 | ..... | ..... | ..... | ..... | 75 | 72 | 3,232,930 | 44,902 |
| Cotton warehouses and gins | ..... | ..... | ..... | ..... | 1 | 1,750 | 1,750 | ..... | ..... | ..... | ..... | 14 | 12 | 68,000 | 5,666 |
| Tobacco | ..... | ..... | ..... | ..... | 1 | 50,000 | 50,000 | ..... | ..... | ..... | ..... | 3 | 3 | 135,000 | 45,000 |
| Miscellaneous | ..... | ..... | ..... | ..... | 5 | 33,347 | 6,669 | 1 | ..... | ..... | ..... | 28 | 23 | 198,947 | 8,650 |
| Grand total | 17 | 218,200 | 12,835 | 1 | 49 | 2,503,752 | 51,097 | 1 | 1 | 20,000 | 20,000 | 451 | 401 | 6,036,490 | 15,054 |

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FARMERS' AND COOPERATIVE GRAIN ELEVATORS.

Farmers' and cooperative grain elevator organizations are usually formed either as cooperative or stock companies with the membership or stock distributed locally among patrons. The capital furnished is in most cases only enough to provide the means of doing business with very little in excess available as working capital. Under this plan of operation a farmers' grain elevator requires a considerable sum of money during the rush marketing season. The elevator pays cash for the grain as it is delivered by the farmer. Several days are required before returns for grain shipped are received, and often grain accumulates in the elevator. The little working capital the elevator has does not go far in paying for all the grain as delivered. It is, therefore, necessary to secure financial assistance from outside sources. This is obtained from banks, commission firms, and individuals.

Using the average amount which was required from outside sources to transact the business of marketing the members' grain, as shown by the reports from 262 elevators (Table 3), it is a conservative estimate to place the total of the amounts borrowed in 1914 by the 3,300 farmers' grain elevators at approximately $30,000,000. This, while a large amount in itself, is small when compared with the total value of the products marketed.

*Security for loans obtained.*—Out of 291 organizations reporting, 99 gave company notes as security for loans obtained; 82 gave no security other than agreements to ship certain amounts of grain to commission houses making the loans; 8 gave mortgages on the elevator and equipment; 5 used company notes indorsed by individuals; 12 used warehouse receipts of grain in storage; 85 were required to give personal security of responsible individuals, who are usually officers of the company, or well-to-do members.

These reports show that as organzations at least one-third of the elevators reporting have no credit that is acceptable to bankers other than that which is given by responsible individuals who assume a personal liability. No cooperative business organization should be conducted along lines such that a few members must assume large personal risks to carry on the enterprise which is of benefit to all members. Members should assume a liability proportionate to the benefits received or the amount of business which they do through the organization.

*Interest.*—Two hundred and ninety-eight elevators report interest rates as follows:

| Rate (per cent) | 5 | 6 | 6½ | 7 | 8 | 10 | 8–10 | 6–7 | 7–8 | 6–8 | 5–6 | 5–7 | 5½–7 | 8–10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number reporting | 6 | 71 | 1 | 110 | 61 | 14 | 3 | 10 | 8 | 2 | 4 | 5 | 1 | 2 |

From these figures it is shown that over one-third of the elevators reporting pay 7 per cent for funds borrowed with which to carry on the business; 71 secured funds for 6 per cent; 14 are required to pay 10 per cent, which may be considered high in itself, but in most cases this is due to the lack of approved collateral security, such as will be accepted by bankers generally. Several elevators have overdraft arrangements with the banks paying from three-quarters of 1 per cent to 1 per cent per month on these overdrafts. If funds can be secured in any other way this latter practice should be discouraged. It is clearly brought out from these reports that rates of interest do not vary regularly in different territories, as, for example, Minnesota elevators are paying from 6 to 10 per cent. Two companies within 10 miles of each other borrow from local banks, one paying 7 per cent and the other 10 per cent.

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In the majority of cases where funds are obtained from commission firms, the rate charged the elevator is 6 per cent, while in some cases as much as 8 per cent is charged. In an investigation by the Office of Markets and Rural Organization, conducted in collaboration with the University of Minnesota, it was found that of 158 elevators in that State borrowing funds, 51 per cent are financed wholly or in part by commission men, the average rate of interest charged being 6.74 per cent, 71.5 per cent partially by local banks, the average rate being 7.39 per cent, 13 per cent also borrowed from individuals, mostly farmers, at the average rate of 6.25 per cent.

*Length of loans.*—Most of the loans made to elevators by banks and individuals are for short periods of from one to four months, or during the heavy marketing season. Forty-one elevators report securing loans payable on demand. Where funds are advanced by commission firms the business is handled on open account and after the year's business is closed final settlement is made. Thirty-five elevators secured loans for improvements on 12 months' time.

Some 14 elevators have arrangements with the company's banks whereby sums not in excess of a certain amount are advanced to the elevators to take care of the business, interest being charged only on funds as advanced. By using this plan interest is not being paid on a large balance.

*Advances to members on warehouse receipts.*—Of 326 elevators reporting, 62 made advances to members on warehouse receipts. These advances range from small amounts to as high as 75 per cent of the market value of the grain. Two hundred and sixty-four report no advances.

As a general rule, it is considered inadvisable to make advances to members on stored grain, as a practice of making these advances brings the elevator into a phase of the banking business which can better be done by the local banks, in that they are especially qualified to do this business. When borrowing from a bank, the patron of an elevator is required to pay interest on the borrowed funds, while at the same time he may object to paying the elevator for a similar loan. He considers the elevator in possession of his grain, hence not entitled to interest on money advanced, as he may assume it is part payment on this property. As a matter of fact he advances not a part payment, but purely a loan, since the title to the grain remains his, he having been given a warehouse receipt. With all its advantages accruing to the profit of the holder, it is therefore clear that loss of interest to the elevator on the money advanced becomes a charge against all the members of the association to the direct benefit of the individual borrowing member, a principle which can not be considered cooperative in any sense. Aside from this, the complications in accounting brought out by the practice should discourage its continuance.

When patrons require loans from the elevator, such loans should be made an open account, or a personal note given, both of which should bear interest in accordance with the prevailing rate.

Sentiment and practice in regard to grain storage varies in the different States in accordance with the prevailing crop, and the sentiment of the terminal market in which the sales are made. In the southwestern and eastern section of the grain belt many elevator companies forbid storing and the practice is in general frowned upon. In the northwestern grain States storing and hedging prevail in about 95 per cent of the elevators. Primary elevator capacity is not sufficient to actually hold all grain offered for storage during the height of the season. This fact has made it necessary for elevators to sell stored grain and to secure protection by hedging in the terminal markets. In certain instances elevator managers have taken advantage of the presence of the stored grain in the elevator, and because of inefficient methods of bookkeeping have

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speculated in futures to the direct loss of their employers. The adverse sentiment which prevails in some producing sections with regard to grain storage is partially due to this fact.

As a rule, an elevator which is financed by a commission firm is handicapped in that it is impossible to take advantage of other markets which from time to time offer better prices than can be obtained in the one in which the commission firm through which the elevator must sell is located. Elevators not dependent in any way upon the commission house can ship first to one market, then to another, and in this way promote competition among the commission men in securing the best prices possible. It must be remembered, however, that the commission houses have served a useful purpose in the financing of the farmers' elevators in that sometimes they gave financial aid when it was impossible to secure it elsewhere. Elevators are turning more and more each year to local sources for their funds, which is a much better arrangement than being dependent upon commission firms, and it has been demonstrated that the elevator which is able to finance its operations without securing any outside help is in a position where the best results can be obtained. An elevator should, as soon as possible, place its business in such shape by the accumulation of a surplus that but little outside financial assistance is necessary. Where outside assistance is needed it is preferable to obtain it from the local bank, using the company's surplus as security, together with the general moral rating secured by conducting the business on a conservative and efficient basis.

It should be only a matter of a short time until warehouse receipts covering grain issued by farmers and cooperative elevators which are known to conduct their business along improved lines can be used as a basis of credit throughout the country.

### FARMERS' AND COOPERATIVE CREAMERIES AND CHEESE FACTORIES.

The average farmers' or cooperative creamery and cheese factory has little difficulty in financing its manufacturing and marketing operations, due to the plan of withholding payment to the producer until returns are received for products shipped. Manufacturing costs are small, and can be met from the returns received from sales. Where funds from outside sources are needed the plant and equipment, in most cases, are sufficient to amply cover any loans secured, and serve as a basis of credit.

As fast as milk or cream is received, it is manufactured into butter or cheese, a large part of which is shipped immediately, very little being held in storage. Payment to the members is made on the basis of the average price which the manufactured product brings less the manufacturing, selling, and miscellaneous costs. These periods vary from 2 weeks to a month. For example, where two payments a month are made, the farmer will receive a check on the 1st of the month for his deliveries covering the period from the 1st to the 15th of the previous month, while on the 15th payment will be made for deliveries from the 16th to the 30th of the previous month. In this way from 2 to 4 weeks elapse between the last delivery of the period and the time the settlement is made. This plan is followed by most of the country creameries and cheese factories in the United States, and there seems to be no objection on the part of the farmer to waiting from 15 to 30 days for his "cream check."

Independent or privately owned factories make use of this practice, which accounts for the success with which the plan has met in conducting the business of cooperative factories. Probably if two creameries were operating in the same community, one cooperative and one independent, the latter paying cash at delivery or for each week's or two weeks' deliveries, at the time of the

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last delivery of the period the cooperative organization would have to conduct its business on the same basis or lose considerable patronage. In fact, this has happened in several instances, making it necessary for the cooperative organization to secure funds from outside sources or by the creation of a surplus with which to cover the amount of the patron's products yet unsold but for which the patron has been paid. The total of these amounts in the average farmers' creamery would amount to several thousand dollars.

The amounts borrowed, as shown by Table 3, were required for meeting the general running expenses of the business, purchase of supplies, and in some cases the addition of new machinery and repairs, and in other instances for making advances to members.

Of 35 creameries reporting on the security given for loans, 14 used company notes, and it was necessary for 14 others to have the personal indorsement of the directors; 2 obtained funds without any collateral security; 3 gave mortgages on the plant and equipment; and 2, which had cheese in storage, obtained funds on warehouse receipts. This report does not take into account sums borrowed for the construction of the factory and initial equipment. At the outset, where loans for these purposes are secured, members have paid in capital stock or membership fees sufficient to furnish a basis of credit for the amounts required, which is usually obtained from banks. In some instances machinery companies extend credit for the equipment.

*Interest.*—Thirty-two creameries report interest rates as follows:

| Rate (per cent) | 6 | 7 | 7–8 | 8 | 10 |
|---|---|---|---|---|---|
| Number | 13 | 8 | 8 | 1 | 2 |

Rates charged vary in the different localities, and depend upon the season, length of loan, and credit rating of the organization.

*Length of loans.*—Seven organizations used borrowed money during 3 months; six from 2 to 3 months (this being in the summer, when deliveries of milk are heavy, advances being made to members); 17 report using borrowed funds from 3 to 10 months, while three are working throughout the year on borrowed capital.

It is interesting to note that not one of the 172 creameries handles supplies. This is in contrast with farmers' elevators, a large part of which do a big supply business.

*Conclusion.*—One great difficulty with the average cooperative creamery is that no provision is made for replacement of plant and machinery, and such repairs, replacements, and improvements as are made are charged against the deliveries of the members until paid, in as large amounts as the business will stand. This is also true in purchasing creamery supplies, such as tubs, salt, butter, etc. Several hundred dollars worth may be paid for out of the returns of a few months' shipments, while the supplies are used for a period of a year or more. The supplies being used throughout the year should be prorated in such a manner that each member contributes to the cost of these supplies in proportion to his year's business with the organization.

Provision should be made whereby a small amount is withheld from the returns, this to be placed in a fund from which supplies, repairs, and improvements can be made. This fund should also be charged with reserves for depreciation on plant and machinery. By using this method funds are available so that it is possible to take advantage of cash discounts in buying supplies and the cost of repairs and improvements can be equitably adjusted. In the setting up of a reserve for depreciation on the plant and equipment, replacements can be made when necessary without special assessments, and money is available to make such replacements when necessary.

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It is surprising to find that but a small number of the farmers and cooperative creameries and cheese factories keep accurate accounting records. There is a dire need for an improvement in the accounting and general business management of these organizations. This phase is almost neglected, attention heretofore having been centered in the manufacturing end of the enterprise. To show the true state of the business, expert audits are badly needed. This condition is recognized by bankers, and has affected the finanical standing of the average farmers' or cooperative creamery or cheese factory.

Many failures occur annually due to various causes, among the more important being: (1) that the enterprise has been promoted to sell the machinery, the community lacking a sufficient number of cows to produce sufficient product to successfully conduct a creamery business; (2) the lack of sufficient initial working capital and lack of support of the members; (3) the failure to provide proper accounting records; (4) poor business management.

TABLE IV.—*Showing the annual business of several of the larger cooperative fruit and produce associations in the United States.*

| | Year ending Aug. 31— | Amount. |
|---|---|---|
| California Fruit Growers' Exchange (citrus fruits) | 1915 | $19,737,850.00 |
| California Fruit Growers' Exchange Supply Co. (members' supplies) | 1915 | 3,319,062.04 |
| Eastern Shore of Virginia Produce Co. (potatoes principally) | 1914 | 5,752,690.36 |
| Monmouth County Farmers' Exchange (potatoes principally) | 1914 | 1,323,443.02 |
| North Pacific Fruit Distributors (deciduous fruits) | 1913 | 3,372,196.30 |
| Georgia Fruit Exchange (peaches) | 1913 | 2,250,000.00 |
| Florida Fruit Growers' Exchange (citrus fruits) | 1913 | 3,500,000.00 |
| Puyallup and Sumner Fruit Growers' Association (fresh fruits; operates 2 canneries) | 1914 | 1,300,000.00 |
| American Cranberry Exchange (cranberries) | 1915 | 1,500,000.00 |
| Florida marketing and distributing bureau (vegetables, fruit, general farm products) | 1915 | 1,500,000.00 |

FRUIT AND PRODUCE ASSOCIATIONS.

Fruit and produce marketing organizations which pool the members' products generally require considerable sums of money in order to meet early marketing expenses and make advances to the growers, as in most cases several weeks elapse between the time the member's product is delivered and returns are received from the market. It is necessary for the growers to have funds with which to meet picking and packing expenses. Owing to the fact that independent buyers are willing to pay for the fruit upon delivery the cooperative organizations at the outset have made as liberal advances to the members as possible. Various plans have been devised whereby the association can secure funds from outside sources. It is impracticable in many cases to accumulate a surplus large enough to meet the early advances in that the money is required only for a short time, and even if it were possible to accumulate a large surplus to take care of the early advances this money would be idle a large part of the year.

Heretofore perishable products have not been considered as good collateral by bankers in making loans to business enterprises. However, perishable products marketed through an efficient organization are now considered good security by many bankers in making loans to such cooperative marketing associations. The amount of money required in handling perishable products will vary according to the size of the business and methods of conducting it. Some which conduct merely a consignment business and do not make advances to the growers need but a small amount with which to meet general running expenses.

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In many cases this is provided by money received from the issuance of stock, membership fees, or the accumulation of a surplus a sufficient part of which is in such shape that it can easily be converted into cash. Many organizations have developed a large f. o. b. business, drawing drafts against shipments and making arrangements with the bank to honor these, placing them to the credit of the association. This gives funds for immediate use and materially decreases the amount of outside help needed in financing. In cases where pools are made, advances to the members are often necessary, as the pool may not be entirely closed until months after the first receipts come in. If it is possible to secure sufficient funds to make the early advances, the returns from shipments as received will take care of other amounts advanced to the growers. In some of the successful produce associations located in the Atlantic States the organization buys the members' product outright, paying for it at the time of delivery. Under this plan of operation large sums are necessary.

*Security for loans obtained.*—Of the organizations reporting on the amounts borrowed, as shown by Table 3, 38 gave association notes as security; 26 gave personal security—that is, company notes indorsed by the directors or individual members who were considered financially responsible. Three report having given no security, bankers advancing funds on overdraft as required. It was necessary for two to give mortgages on the packing plants. One association has secured in the neighborhood of $300,000 from bankers on warehouse receipts covering nuts in storage. One secured a large loan from bankers on warehouse receipts for apples which were in storage.

From these figures it is shown that over half the organizations are able to borrow the necessary funds to make advances to members and to meet the expenses of the early marketing season, without security other than that which the organization can give. A surprisingly large number, or 26 out of 72 organizations, are so organized that it requires the personal security of directors or members to finance the operations.

*Interest.*—Seventy-two organizations report rates of interest as follows:

| Rate (per cent) | 6 | 7 | 6–7 | 7–8 | 8 | 8–10 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|
| Number reporting | 28 | 10 | 3 | 7 | 20 | 1 | 5 | 2 |

From this it will be seen that the rates of interest vary from 6 to 12 per cent. The two associations paying 12 per cent are badly in need of reorganization, and have had considerable difficulty in obtaining funds. The money which is procured is used for short periods and commands a high rate of interest. The associations on the Atlantic coast and in the Middle West, as a rule, secure funds at the rate of 6 per cent. Some of the larger organizations on the Pacific coast, owing to the large amounts which are borrowed, and their excellent business standing, are able to secure loans at from 6 to 7 per cent, while the rate which is charged individual producers by the banks is considerably higher. One of the large distributing agencies in the Pacific northwest borrowed in the neighborhood of $400,000 in one season, most of which was advanced to members for deliveries of fruit. The five organizations which report a 10 per cent rate borrowed small amounts at the time of the year when money in farming communities commands a premium. However, these organizations have an insufficient amount of capital, and from a business point of view are paying at least 2 per cent more for the money than would be necessary if the organization were conducted along more conservative lines and a surplus set aside to help carry the expenses of the early marketing season.

*Length of loans.*—Of 74 associations reporting on the period for which funds from outside sources were needed, 21 report requiring outside assistance only

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during three months, or during the early part of the marketing season; 7 require funds for 6 months; the others varied from 1 to 12 months, the larger part of them, however, being for a short period, or from 1 to 4 months.

It is possible to make advances amounting to a high percentage of the total amount due the grower only during years of good marketing conditions. In years when markets are bad, it is necessary to be very conservative in making advances as there is a possibility of overpaying. The fruit held in storage may not produce the returns which were anticipated in the early season. In 1913 it was possible for the large distributors in the Pacific northwest to secure advances on apples, a good many banks soliciting this business, and offering to loan as high as $1 a box at 6 per cent interest on all fruit in storage. However, during 1914, when there was a large crop and markets were more or less demoralized, it was almost impossible to secure advances from banks or cold-storage companies. One large packing firm, however, offered to make advances of 12½ cents per box at 8 per cent interest. Upon the improvement of conditions later in the season it was possible for the large distributors to negotiate a big loan on the basis of 35 cents a box. This was for only fancy and extra fancy, however, which were the best storage stock. In spite of this situation, however, the stronger growers' organizations in the Pacific northwest were advancing as much as 40 cents per box on all varieties, grades, and sizes, to the growers, which was an exceptionally liberal advance, and showed that the organizations were in a condition enabling them to finance the grower to a considerable extent, even in a period when marketing conditions were unusually bad.

*Successful plans now in operation in financing.*—No two marketing organizations which handle fruit or produce operate under the same plan. The method of conducting the business, products handled, distance from markets, and various other elements require that the plan be suited to local conditions. For this reason it is thought well to give in brief the plans of financing as developed by several of the more successful organizations.

*Wenatchee Valley Fruit Growers' Association.*—The success of the plan of this organization is due to the demand which has been created by the association for its product. The apples shipped are well graded and comparatively uniform from year to year and are marketed under the association brand. The product of the association is sold through agents. These agents are generally wholesale dealers in produce. A contract is entered into between the organization and agents, and among a great many other things relating to the marketing, this contract provides that upon signing the agent is to advance the association from $50 to $100 per car on the number of cars contracted for. This money is used in making early advances to the grower, some growers having received financial aid this year as early as May. At the time of shipping the 50 cents and 30 cents per box advance which is received from the agent is paid over to the grower, less the early advances which have been made to the member. Funds for the early advances are secured from banks. Credit is also extended the grower for boxes, paper, and nails. As sales are made and returns received, additional payments are made to the grower. A great many apples are placed in storage in different sections of the country, and advances similar to those made by the agents are made by the storage people. The fruit itself is used as a basis of credit, and the grower is not only financed in his harvesting, but sufficient funds are secured to take care of all transportation and other incidental costs.

*Yakima Valley Fruit Growers' Union.*—Provision is made for financing the association under a plan which calls for a box reduction from the returns of

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all fruit shipped through the organization. These deductions are considered as a loan to the association, and are represented by notes payable three years after date, with 4 per cent interest coupons attached. The first season brought in a surplus of $50,000. If there is no change in the volume of business the fund will amount at the end of three years to $150,000, and will thereafter be held automatically at that figure, except as it fluctuates with the increase or decrease of the volume of business. This provides a sufficient working capital, furnished by and belonging to the growers in exact proportion in which they from year to year make use of the privileges of the association. In case they, for any reason, sever their connection, the capital contributed by them is returned as the notes mature. This surplus is a basis of credit, and gives a cash amount with which to purchase growers' supplies, and pay the general running expenses before returns are received from the season's marketing. The current running expenses of the association are met by the usual system of charges on the fruit handled. Supplies are furnished the members. Pro rata deductions are made from crop returns of members in payment of their supply account.

*Puyallup and Sumner Fruit Growers' Association.*—This organization secures funds with which to operate during the canning season from banks and members of the association. Funds are borrowed from the members on demand notes bearing 8 per cent interest. These notes are payable without notice, and interest earnings are payable to the date of withdrawal. Amounts varying from $10 to $4,000 are deposited by the members with the association under this arrangement. Local savings bank rate is 4 per cent, so that members by depositing with the association made 4 per cent over the rate which would be secured if the money were placed with a savings institution. The member having money on deposit with his organization is more apt to take an active interest in the association and in the development of a true spirit of cooperation. Four banks furnish the additional capital necessary for the year's operation. It is the policy to borrow in small amounts from time to time as the money is needed. In the past year one bank loaned $50,000; one $35,000; one $20,000; and one $10,000, the latter three amounts having been loaned by local banks. This money is secured on an association note. A trainload of sugar was purchased this past year in one lot, being paid for in cash, amounting to approximately $85,000. The money for this purchase was advanced by one of the larger banks in the Pacific northwest. The sugar was placed in a warehouse and taken out in amounts as required by the organization, and as taken out was paid for, the local bank keeping track of the amounts drawn out and having the key to the warehouse. By this purchase the organization secured the sugar at such a price that many thousands of dollars were saved over what it would have been necessary to pay had it been purchased in small lots throughout the season. This clearly shows the financial standing this cooperative organization, which has a capital stock of but $2,500, has in the banking world, and demonstrates that all that is required to properly finance a cooperative marketing organization is an efficient management and a plan of operation such that the business is conducted along sound and recognized efficient lines.

*North Pacific Fruit Distributors.*—The following is quoted from the annual report of the North Pacific Fruit Distributors:

During the past season a total of $500,000 was made available for advancing to the growers of our respective districts. This was in part from funds on hand in local or subcentral reserve funds, in part from bank accommodations arranged with local banks by the subcentrals, and in part through bank loans arranged by the central office, and what is most gratifying to note is that over $400,000 additional was voluntarily offered us by Spokane banks upon growers'

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warehouse receipts. This, however, we had no occasion to use. No one fact stands out in bolder contrast with the past than does this tribute paid by conservative bankers of the Northwest, when they so completely reverse former practices, and either loan or offer to loan nearly $1,000,000 for advances upon a product so perishable in nature that it had heretofore been regarded by them as an utterly impossible security. It is interesting to note also that the amount borrowed was repaid on or before maturity of the loan, and the greater part even before maturity.

The success of the financing side of this organization is due to a just and equitable plan of pooling like varieties, grades, etc., of fruit, each district within itself, and through business-like methods of bringing to the industry such stability that the fruit products as marketed were considered safe and perfectly acceptable collateral. The man who loans to an association, having perishable products as his collateral, must have confidence in the ability of the association to sell the product to the greatest advantage. Further he must know that the fruit is picked at the right time, properly packed, and sold at a fair price.

*Eastern Shore of Virginia Produce Exchange.*—This organization buys the product of the member outright, paying the daily quoted price, the agents at the various stations giving the grower a check for the total amount of the produce within at least two days of the time delivered. During the year the prices paid to the grower are adjusted from time to time so that no loss is sustained by the exchange. This method in reality acts as a pooling of the product as the returns to the grower will strike an equitable average during the year. This method requires a considerable sum of money during the early marketing season. The banks in the town in which this organization is located are small; it is therefore impossible for any one bank to loan all the money which is required by the exchange. Sums are therefore borrowed from various banks in the vicinity, and where necessary outside banks assist. Some years as high as $200,000 is required, while in others a much smaller amount is needed. Capital stock of this organization, together with the surplus, is a little over $197,000, so it is possible to carry on considerable part of the business with funds which belong to the organization. In 1914 approximately $200,000 was required from outside sources, the largest loans secured from any one bank being $35,000, which was obtained from a bank in Philadelphia. All the business of the organization is handled through one local bank, which acts as the financial representative of the organization. Practically no difficulty is now experienced in securing sufficient funds with which to carry on the business. During the last few years no security has been required for loans other than association notes, and such loans as are negotiated bear six per cent interest.

### GENERAL CONCLUSIONS.

Many of the organizations which have high-credit ratings are protected by contracts in which the grower agrees to deliver all of a given product to be marketed by the association. The loyal and regular support of members plays an important part in building up the credit of a cooperative marketing association, and too much emphasis can not be placed upon this point.

Many banks owing to the limit set by law upon a certain percentage of the capital and surplus which may be loaned to any one individual, can not furnish all the funds which are required by the local marketing association. In cases where this is true it is well to use the local bank as a medium through which loans can be secured from nearby banks or from those in financial centers.

There are many advantages to be had in having a man as director of the organization who has had banking experience, who may even be a member of the loan committee of the local bank through which the organization transacts its business.

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At this time in the neighborhood of 225 farmers' elevators are using the Government's uniform system of accounts, devised by the Office of Markets and Rural Organization of the United States Department of Agriculture, and indications are that some 500 will be operating under this system within the next six months. A great many fruit and produce associations, cooperative canneries and other farmers' marketing organizations are using the uniform systems devised by the department for these businesses. A set of creamery records is now being tried out, and will soon be available for these enterprises. The use of these systems furnishes means whereby it is possible to fix the standards of efficiency of operation, and ascertain the rate of cost of doing business under varying conditions. These uniform records will also allow the comparison of one business of a given type with another, and it will be possible in many cases to increase the operating efficiency of a large number of concerns which heretofore have been conducted in a manner such that it was next to impossible to accurately ascertain the status of the business and the margins on which it should work. The standardization of the accounting records and the economies which will be effected in the operation of the businesses, and expert audits, will all tend toward increasing the borrowing capacity and in the long run result in an improvement which will place on a stable basis many farmers' organizations which have heretofore had considerable difficulty in securing outside assistance in the financing of the marketing of the members' products.

## MODERN RETAIL MERCHANDISING.

By C. C. PARLIN,

*Manager, Division of Commercial Research, Advertising Department, The Curtis Publishing Co., Philadelphia, Pa.*

Men and women differ in their buying. Men in their buying are usually impelled by one of four influences:

1. *Convenience.*—Where is the nearest place a desired article may be found?

2. *Impulse.*—Walking down the street he is struck by a window display and unexpectedly makes a purchase.

3. *Custom.*—He goes in a routine way to an accustomed place where he is known, and the merchant greets him, "Good morning, John," and he says, "Charge it, Bill," and goes away without encountering any red tape.

4. *Brand.*—He may go some distance out of his way to find a desired brand of overcoat or hat or collar.

### CONVENIENCE GOODS AND SHOPPING LINES.

Women's purchases are of two distinct classes, which we may call "convenience goods" and "shopping lines." Convenience goods comprise notions, cottons under 15 cents a yard, stockings for the children, and, in general, the lower end of women's purchases. These lines are bought in the same manner as men buy—(1) at the most convenient place, or (2) by impulse, or (3) at an accustomed place, or (4) by brand. There is little or no comparison of values.

Shopping lines in general comprise the upper end of women's purchases, such as cloaks and suits, carpets, millinery, drapery, and the better grades of hosiery and underwear. In purchasing these lines a woman does want to compare values. She wants to go to one store, then to a second, then to a third, and after having seen three stocks, and having compared quality, price, and style, to make her choice.

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### WHAT MADE THE DEPARTMENT STORE?

This tendency of women to shop has made possible the department store of to-day. Historically, most department stores have grown out of dry goods stores, but logically the department store is a store that sells all lines which women buy by comparing values, whether dry goods, jewelry, or hardware.

The department store manager in judging the fitness of any line should ask himself two questions:

1. Do women buy this line? For the department store first, last, and all the time is a woman's store. Man is not a shopper; he is antishopping, and therefore patronizes but little the organized shopping store.

2. Is this a line in which women wish to compare values? If it is, the department store group can capture the great bulk of the trade of the city; but if it is not bought by comparison of values, the department store group can capture only a minor portion of the business, and the major portion will be scattered among a multitude of specialty houses and small shops.

### WOMEN'S STORES.

There are three classes of stores for women's purchases: (1) Department stores; (2) specialty shops; (3) convenience stores.

In addition to these women's stores, there are men's stores; but these are for the most part analogous either to the specialty shops or the convenience stores of women's lines. Let us then consider briefly each of the three fundamental types of stores.

*The department store.*—The department store, as already stated, is founded on women's shopping, but it carries a certain amount of convenience goods. As you approach a department store you see in the windows displays of cloaks, suits, draperies, and other shopping lines. When you step inside you find that these lines are on the second or the eighth floor, and that you must pass along counters of gloves, handkerchiefs, notions, and other convenience articles in order to reach the elevator. The department store manager has discovered by experience that there is only about 33⅓ per cent chance of selling the woman who comes to the second floor to look at cloaks and suits, but he has discovered that if he can put enough hurdles loaded with convenience articles between the front door and the elevators he can sell his visitors enough convenience goods as they pass in and out of the store to pay to wait on them upstairs when they do not buy.

The problem of selling convenience goods in a department store is identical with the problem of the convenience shop, for the department store, like the specialty shop, sells these goods without a comparison of value and secures trade (1) because it is the most convenient place, or (2) because it attracts attention with its display, or (3) because it is the customary place for a woman to buy, or (4) because it carries the desired brand.

*Concentration of shopping lines.*—The strictly characteristic thing about a department store, therefore, is the fact that it furnishes facilities for women's shopping and hence has the opportunity to sell in a large way the shopping lines. Since shopping lines are bought upon comparison of values, no store can secure and permanently hold a monopoly in the sale of any shopping line; for women can not compare values if there be but one stock. As a matter of fact, a woman appears to want to compare values in three stores. Why three I do not know; perhaps it is the limit of her endurance. But whatever may be the philosophy, it is evident that three is the magic number in woman's

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shopping; for in almost every city where shopping lines are carried you find just three important stores with these lines—seldom less and seldom more—until you reach cities of 25,000 population. Then the number increases very slowly. There are only three cities in the United States which have more than seven department stores that, in our judgment, are doing more than $1,000,000 of business each. The sale of shopping lines, therefore, is sharply concentrated into a few stores in each city.

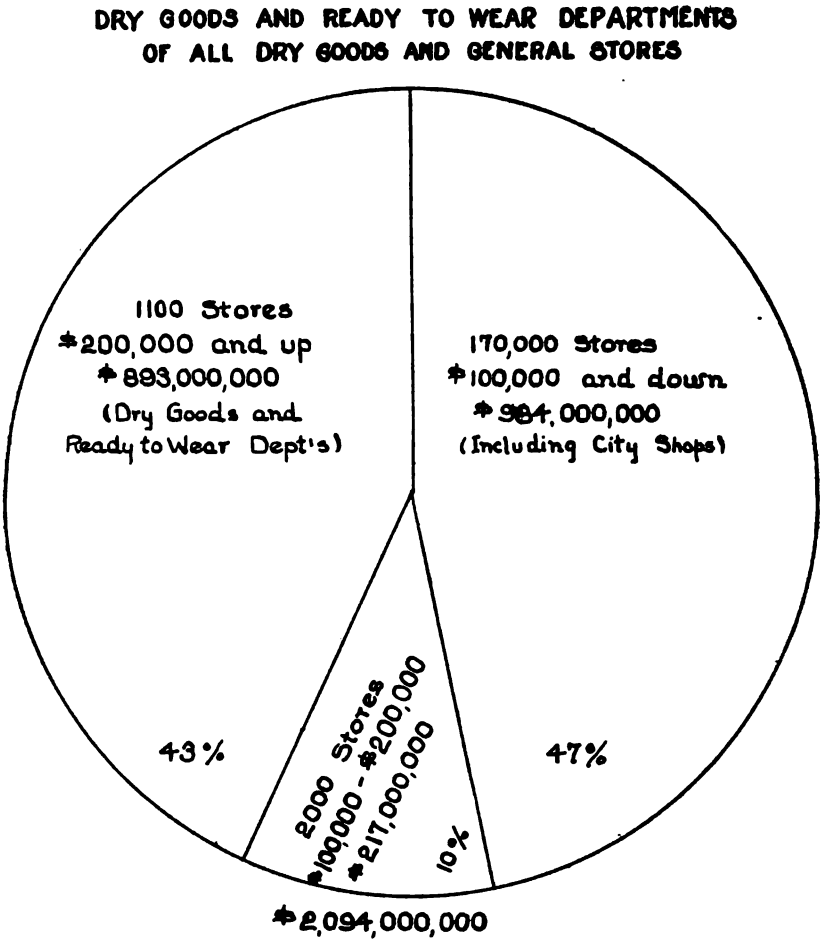


Chart I.

The sale of shopping lines is also concentrated into a comparatively few cities. Cities may be divided into two classes—shopping centers and suburban cities. A shopping center is a city that draws more trade from outside than it loses to other places. A suburban city is one that loses more trade than it draws in from the outside. The importance of the distinction lies in the fact that the city which draws trade draws it in shopping lines, and hence has a group of shopping stores; while the city that loses more trade than it draws loses it in shopping lines, and its stores tend to become merely shops of convenience goods. The distinction between shopping center and suburban has little reference to the size of a city. Some of the suburbs of New York and

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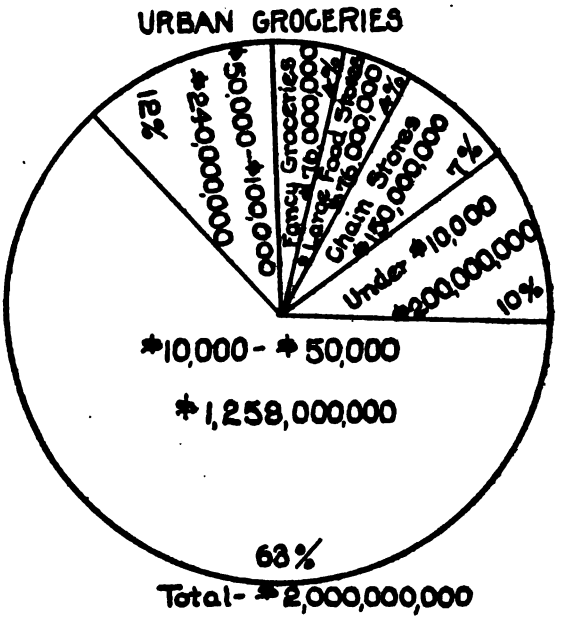
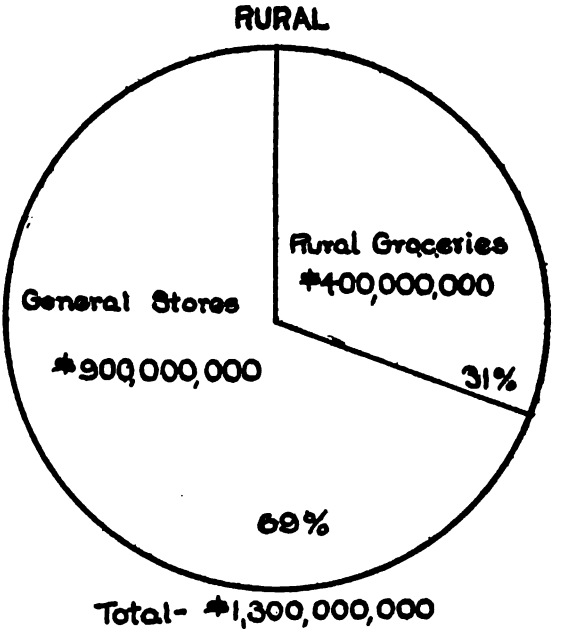



* Includes Grocery Business of Department Stores




URBAN AND RURAL GROCERIES.

Chart II.

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Boston, with 100,000 population, are suburban, their stores for the most part carrying only convenience goods; while a western village with a population of 2,500 is often a shopping center to which 10,000 people come to make their purchase of cloaks, suits, draperies, and other shopping lines.

*Significance of concentration to manufacturer.*—Thus we find that shopping lines are sharply concentrated into a relatively small number of cities and into a very small number of stores within each city. Hence if a manufacturer has a shopping line the number of stores which can profitably carry his line is so small that he can afford to cover his field with his own salesmen, selling direct. If, on the other hand, the manufacturer has a convenience line, to get anything like an adequate representation he must reach the suburban cities and the rural stores. To him, therefore, the jobber is essential.

*A study in volumes.*—It is for this reason a matter of considerable importance to know what per cent of the trade in dry goods and ladies' ready-to-wear is shopping lines and what per cent is convenience goods. To determine this we made in 1912 a study of the textile jobbing and retailing situation in every one of the 100 largest cities, and also in a considerable number of minor cities in different portions of the country, traveling 82,000 miles and interviewing more than 1,000 manufacturers, jobbers, and retailers.

In each city we estimated the volumes of business of the department stores individually and added them. On the basis of these estimates we also made estimates for those cities to which we did not go, and reached the conclusion that the total amount of dry goods and ready-to-wear business in the United States was in 1912 about $2,094,000,000, exclusive of that done by the catalogue houses.

Of this $2,094,000,000 we estimated that about 43 per cent was done by about 1,100 stores that do more than $200,000 each, and that 47 per cent was done by a multitude of small stores that do under $100,000 of business each, leaving 10 per cent for the class between. (See Chart I.)

*Attitude of stores on direct buying.*—Now, a store that does more than $200,000 of business per year ordinarily wishes to buy direct, partly to secure a portion of the middleman's profit and partly as a matter of pride. On the other hand, a man who is doing less than $100,000 prefers to buy of the jobber; he wants to keep his stock down, and often he is financially weak and leans on the jobber. Of the class between, some merchants prefer to buy direct and some prefer to buy of the jobber. If, therefore, we divide this class between the other two, it indicates that 48 per cent of the textile stores prefer to buy direct and 52 per cent prefer to buy through the jobber. Of course, large stores buy some things from the jobber and many smaller stores buy some things direct, but if we offset one against the other and divide the 10 per cent of the middle class evenly it indicates that 48 per cent of textiles goes through direct channels and 52 per cent goes through jobbing channels. But since shopping lines are concentrated in the larger stores, much more than 48 per cent of shopping lines tends to seek direct channels, and, conversely, much more than 52 per cent of convenience goods seeks an outlet through the jobber.

Therefore, if a manufacture has a shopping line, his opportunity is so sharply concentrated in a small number of stores that he can afford to use the direct selling method exclusively; but the manufacturer of a convenience line finds his major outlet through the jobber. He does find, however, that the volume of certain large department stores is considerable and that these stores insist on buying direct. As a matter of fact, about one-half of the 43 per cent we have accredited to stores doing over $200,000 each is done by about 200 stores, each one of which does over $1,000,000. These stores ordinarily insist on buying direct and the jobber realizes that he can not successfully sell them. The manu-

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facturer with a convenience line, therefore, will ordinarily find it advantageous to sell direct to the 200 stores that do over $1,000,000 each, and use the jobber for the rest of his distribution.

*The specialty store.*—The specialty store exists primarily for the purpose of selling to those exceptional women who buy, as men buy, without shopping. The specialty house that tries to build a business on a shopping principle finds itself ordinarily at a disadvantage in competing with the more fully equipped department store. But the specialty house that aims to develop the regular custom of those women who do not enjoy department store buying finds a real, though not a very large opportunity. It seems improbable that the specialty shop will replace the department store; on the other hand, it seems not at all likely that the department store will be able to entirely supplant the specialty houses.

*Convenience stores.*—Convenience stores exist for the sale of a great multitude of minor articles of daily purchase that are bought without shopping. The group includes grocery stores, delicatessen, meat markets, cigar stores, haberdasheries, candy shops, small textile shops, small hardware and electric supply stores, and last, though not least in importance, drug stores. The drug store originally, as its name indicates, filled prescriptions and sold medicines, but gradually it came to acquire that long line of miscellaneous convenience articles that do not fall particularly to any of the other convenience stores. It became, so to speak, a residuary convenience store to sell everything that was not handled by some other shops.

The problems of all these types of convenience stores are similar, and may be most advantageously studied in the grocery field, both because of the vastness of the grocery volume, and because the grocery retail system is more intensively and highly developed than that of any other line.

*A study of grocery merchandising.*—During the years 1914 and 1915 the Commercial Research Division has been studying the problems of grocery merchandising, having visited 151 cities, and having interviewed over 1,000 manufacturers, jobbers, and retailers in every portion of the country. On account of the vast number of retail outlets, it was impossible to determine accurately the volume of retail grocery business, but at a conservative estimate the amount of food products passing through retail channels reaches $4,500,000,000—more than twice the volume of dry goods and ladies' ready-to-wear, the largest of all American retail lines.

*The down-town store.*—To better understand the problem of grocery retailing, which is the problem of all convenience-goods selling, let us visit in imagination a typical city.

In the down-town district we find, in the first place, some of the old-time down-town grocery stores. Twenty years ago the grocer prospered. He had an average cost of perhaps 15 per cent. His gross profit exceeded 20 per cent. For his clerk he got his pick of the bright high-school lads. But times have changed. Costs have crept up to about 17 per cent; gross profits have settled down to about 20 per cent. He no longer secures the bright high-school lad, for this lad prefers to be a chauffeur, or, perchance, to drive the laundry wagon and have the evenings for the movies. As costs have crept up and the grade of his help has deteriorated, wastage and petty thieving have increased, and his 3 per cent net has tended mysteriously to disappear.

The fact that these stores still remain indicates that it is still possible to make ends meet. The fact that as a class they appear not to be prospering indicates that there is not much future for them.

*The fancy grocery.*—To solve the problem of the downtown store two means have been tried—one, to secure larger margins; the other, to seek greater

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volume. The former has given rise to the fancy store. In nearly every community there are some exceptional people who will pay an extra price for the best, and there are many people who will buy extra-priced articles for exceptional occasions. This trade, like the shopping trade of the textile lines, tends to concentrate, but unlike the shopping lines, the goods are bought without comparison of value, hence there is nothing to prevent a single store securing a monopoly and frequently a single grocer does secure a marked leadership if not a positive monopoly of fancy lines. The chief difficulty with these stores is to secure sufficient volume and to supplement the rather limited trade in fancy groceries. In many large cities the fancy grocers have added wines and liquors.

*The large food store.*—The second method has been to seek volume. The grocery trade, like all convenience-goods trade, tends to scatter among a multitude of small shops, but to some extent this tendency may be overcome if a downtown store offers sufficient inducement in price, service, or merchandise. That this can be done in the grocery field has been demonstrated in Providence, Toledo, Norfolk, and a few other cities; and the large downtown drug store is a familiar institution in many cities.

*The grocery department of the department store.*—In addition to these three types of downtown groceries one sometimes finds a grocery department in the department store. The department store manager sometimes institutes a grocery department with the thought that it will attract other trade to his store; women will come to buy groceries and will linger to look at cloaks and suits. But, as explained above, cloaks and suits are not bought in that manner. Women go to the department stores primarily because they want to look at cloaks and suits and other shopping lines. While there, incidentally they may buy groceries. That is, the department store may sell groceries in the same manner as other stores sell them, by being the most convenient place or by attractive displays or by becoming a customary place for daily purchases or by carrying desired brands.

It is a mere incident that the grocery department is the department store, and it may be any one of the three types of grocery stores just mentioned. It may be a private brand department with the aid of wines and liquors. More often it is the large food shop. Most often it is neither one nor the other, but like the old-time down-town grocery halfway tries for margin on private brands, halfway seeks volume, and between the two, little more than makes end meet.

*The suburban stores.*—Having covered the down-town group of grocery stores we may feel that we are ready to move on to the next city, but if we chance to look in a telephone directory we are apt to find listed about one grocery store for every 400 of population, and if we look in a city directory we may find half again as many. That is, in a city of 400,000 population we may find 1,000 groceries listed in the telephone directory and 1,500 listed in the city directory, and if any considerable volume of business be assigned to each of this multitude of stores it becomes obvious that the down-town group is a minor factor. In a city of 400,000 population the down-town group is apt to do about 10 or 15 per cent of the business of the city, and rarely does more than 25 per cent. In a city of 25,000 the down-town group is likely to do 25 per cent, but rarely 50 per cent of the business.

*The corner grocer seeks margin.*—The outside stores are of two types—the "corner store" and the "chain store." The real problem of grocery retailing may be seen in the small corner store. Let us take one that has $200 a week coming in and $35 a week expenses—17 per cent expense; 20 per cent gross,

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with a 3 per cent margin which tends to disappear in wastage and petty thieving. Let us assume that we have a smart man in charge, and he asks himself the question, "Can I not in some way make money in this store? My gross margin is 20 per cent, but on many lines I might get 25 per cent. I will push those lines that have the longer margin." So when a customer calls for tea he sells the tea that bears the longest margin, and when a customer asks for tea that bears a short margin, he tactfully urges him to try his favorite brand which bears the longer margin. Apparently, he succeeds in this salesmanship, for the customers take the tea he offers and does not return to complain of the quality of the tea. The real trouble is that the customer does not return for tea at all, but simply buys tea at some other store. Hence, in spite of his clever salesmanship, or, perhaps more accurately, because of his clever salesmanship, his trade mysteriously drifts away, and as his volume sinks his expenses rise, and even with the longer margin he is no better off than before.

*The corner grocer seeks volume.*—If the grocer is really smart he will recognize the failure of this plan, and will say to himself, "I am going to seek, not greater margin, but greater volume. I now sell $200 a week with $35 expense. If I could sell anything more than $200 per week without increasing my expense, the entire gross on the additional sales would be net. If I could sell $300 of merchandise at $35 expense, the entire 20 per cent gross on the extra $100 would be net, and I would have $20 a week net, and this would not be a bad business." But how can he get volume? In the first place, he must sell what people want. Perhaps he takes all the kinds of tea home and tastes them, and honestly recommends to his customer the kind that best pleases his own palate; but his taste is the taste of only one man and may be at variance with his entire community. The manufacturer who has advertised to 100,000,000 people, and succeeded in getting any considerable portion of the national market, is the one who has most successfully found the average taste. Hence, if our grocer be really a shrewd man, instead of studying tea, he will study what is called for, and sell to every customer that brand which most customers are demanding, on the theory that that will be most likely to produce return orders. For in the grocery business individual sales are of such small amounts that the margin of profit on any one sale is inconsequential, and money can be made only by repeated orders of regular customers. Our grocer, therefore, is selling what is wanted; and where national advertising has been strongly used, advertised brands are demanded.

He must also run the kind of a store that his community wants—neat, clean, sanitary. He must furnish the kind of service his community is willing to pay for, be accurate in his accounts, make the best of his opportunities for window displays. Let us assume that he sells what people want, that he runs the kind of store that people are willing to patronize, and that he gets the extra $100 of business.

The next question is, How can he maintain his expenses at $35? Light, heat, rent, telephone, may all be the same. If he tickles the old horse with the whip it may deliver a big load, but how can he handle the congestion of customers in the rush hours? He finds that he must speed up his sales. He must learn to be polite without stopping to talk about the Fair or the baby. He must sell Mrs. Smith one thing and Mrs. Jones something else promptly. He finds that he has no time to push anybody's brand—his own, the jobbers, or the manufacturers. The only thing that he has time to do is to push out that merchandise which moves the quickest and which will most certainly bring the customers back for return orders. This grocer has discovered the key to success in retailing—the problem of increasing volume and holding expenses

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down. He has become, frankly, an order taker because he has found that it is order taking that pays best. This is equally true of the large downtown store. If you visit one of these large food stores you will find that they are selling a large quantity of unbranded staples, such as potatoes, and are selling their private brands in those lines in which national advertising has not been strongly enough used to secure a consumer demand, such as canned vegetables and spices; but the most striking thing about the store is that it is almost an exhibition room of well-known brands. That is, the large food store to succeed must get volume and to get volume must sell what people want, and where national advertising has been effectively used people want advertised brands.

*The chain store.*—But how about the chain store? The smart man whom we took as an example when he made a success of the corner store, when he made his $20 a week net profit said: "This is not a bad business, but I ought to have two of them." Then he wanted 4, then 8, and gradually he grew until he had about 20; and then with confidence in himself rapidly expanded and developed a chain of several hundred outlets. But in order to make a success of the chain he must make a success of each unit and the problem of making a success of the unit is essentially the problem stated above for the corner store. He must get volume in proportion to expense and to get volume he must sell what people want. Where no particular brand is desired he may sell his own brand or unbranded merchandise, but where any brand is definitely demanded he can not afford to do otherwise than handle it, for it is quite as true of the chain store as of the individual grocer that it does not have time to push anybody's brand. Its problem is to sell as speedily and efficiently as possible those brands which will most certainly develop customers.

So it is, too, with grocery departments of department stores. Those that are seeking to escape the rut of grocery retailing through volume are selling what people want, seeking profits in larger volume and low expense rather than in longer margins.

### THE DEPARTMENT STORE AND ADVERTISED BRANDS.

But turning from the grocery field where we have found that the key to success in selling convenience goods is order taking let us consider the situation in dry goods and ready-to-wear, where the problem is that of shopping lines. What is the attitude of department stores toward selling branded merchandise?

In general, the attitude depends upon the store's cost of doing business. The store with a low cost that can make a profit on advertised brands is usually pleased to carry them. The store that for any reason has high costs feels it necessary to sell noncompetitive merchandise in order to hold its own in competition with stores of lower cost and in order to get above its own high cost of doing business.

Costs of doing business vary according to three things: First, the larger the city the higher the cost; second, the farther from the central markets the higher the cost; and third, individual stores vary, depending partly on the skill of management and partly on the grade of merchandise, for in general the higher the grade of merchandise the higher the costs are likely to be.

*The problem of the department store.*—In general, the problem of the department store is the same as that of the convenience goods store in the great fundamental, which is that to make a profit it is essential to get volume in proportion to expense, and to get volume it is necessary to sell what people want; and, where national advertising has been effectively used, people want advertised brands. In lines where advertising has not been used, the department store can, of course, effectively sell unbranded merchandise or private

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brand goods, but where a definite consumer demand has been created for a manufacturer's brand, any insistence upon the part of the department store on its own brand is apt to lead to a curtailment of volume and therefore to an increase in cost.

A new department store starting in a community most easily gets a start by pushing the advertised brands, and a well-established department store seeking to expand its volume finds the line of least resistance in advertised brands. Hence a department store to increase it own volume or to protect itself against inroads from a competitor who is pushing advertised brands, finds it advantageous to sell fairly those lines of advertised merchandise which have quality and for which a consumer demand has been created.

The advisability of doing this is more evident from the fact that the department-store volume of business for any city is at any given time a fairly definite amount that is determined by the economic conditions surrounding a city. For every one of the 100 largest cities we estimated the volume of department-store business, and also estimated a trading population; that is, the number of men, women, and children who were represented by the people who came into this city to buy shopping lines. Dividing the trading population into the department store's volume of business, it was found that the average per capita expenditure was $30.94. Some cities were higher, others lower, but the interesting fact portrayed by the figures was that in practically every case of variation from normal an economic reason could be found for the variation.

These figures made it apparent that within any given area the volume of department-store business is a fairly definite quantity. In such a territory there is in the hands of the women a certain definite amount that they may spend. Of that a fairly definite proportion will seek the channels of concentrated trade and a fairly definite proportion will be spent in specialty houses and convenience stores.

*How to increase department-store volume for a city.*—In a city where department-store methods have been fully developed the volume of department-store business can be materially increased in only one of three ways:

First. By increasing the population or improving transportation facilities, so that a larger number of people can advantageously come to the center.

Second. By increasing the prosperity of the community, so that a larger amount of money is in the hands of the people to spend.

Third. By the addition of new lines to the department stores.

Recently in a large American city a material expansion in department-store activity took place. Ten million dollars of additional business was needed to render profitable the new buildings and the expanded stocks. But the department-store group of this city was already receiving the full amount that that community had to spend in the channels of concentrated trade. No new methods of display or exploitation were able to produce the amount, and disaster was inevitable.

### IMPORTANCE OF MERCHANTS.

We would not be understood as minimizing the value of the service that has been performed by the great leaders in retail merchandising. A few leaders have shown the way; many others have followed and have adapted the methods of the leaders to meet local conditions, and department-store methods, as they exist to-day, are the creation of many able minds. But the point I wish to make is that certain economic conditions render possible a certain volume of concentrated trade, and the service which our great merchandising leaders perform

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is in supplying facilities for shopping trade, and when the facilities are offered the trade comes naturally.

Since, then, the volume of business of the department-store group is a fixed amount, and the small group of stores are competing among themselves for the major share of this fixed total; that store which best caters to the wants of its community—that is, the store which most efficiently sells the merchandise the community wants in the manner in which it wants it sold—is the one that gains in volume, and any store that tries to supplant well-known brands with private-brand merchandise is likely to face a shrinking volume and an increased selling cost.

### WHAT IS A MERCHANT?

But sometimes a merchant says, "If I sell advertised brands I become a mere slot machine." That man has misunderstood the definition of a merchant. He defines a merchant in his own mind as a judge of merchandise, a man who tastes tea and estimates the picks and counts of a fabric. But the dictionary defines a merchant as a man who buys and sells, and practical business proves the definition correct.

The function of a merchant is not to study merchandise, but to study human wants and how most efficiently to meet them. Old-time merchandising consisted in pushing a product out. The manufacturer pushed it out to the jobber, the jobber by his salesmanship pushed it out to the retailer, and the retailer in turn pushed it out to the community.

### MODERN MERCHANDISING.

Modern merchandising, on the other hand, is the merchandising of pull. The manufacturer appeals to the consumer, who makes his demand on the retailer, and he in turn on the jobber, and the jobber in turn on the manufacturer. This change is strikingly illustrated in the automobile industry. Ten years ago the retailer sold what he pleased. If he were an ex-bicycle man he looked over the mechanics of a car and said, "This is the best car; I will recommend it." If he were nephew of a rich uncle he went to New York, was entertained at a show, and said, "That is the best group of fellows; I will sell their car." In any case, he sold to his community that which he had to offer.

But to-day when one travels the country over and asks in each city what is the order of sales of automobiles in this city, he finds that the order of sales of cars in practically all cities of importance is almost identical so far as the leading six or eight cars are concerned. That is, the influences to-day selling automobiles are not local influences, but national. The three national influences are: First, the merit of the product; second, the strength of the national advertising; third, the efficiency of the national sales organization.

Does this mean that the dealer is an inconsequental factor? By no means. But it does mean that the strong dealer finds that he can sell a bigger volume and therefore make more money by handling a nationally popular car, and he seeks a leading company. Every company wants the strongest dealer; hence, impelled by self-interest, strong companies and strong dealers gravitate together and develop business to the mutual profit of each other. So, too, in every line of merchandise it is equally true that it is to the interest of the dealer to link his selling ability to the merchandise of the manufacturers who create a favorable presumption on the part of the buying public.

We may talk about manufacturers, jobbers, and retailers, but in the last analysis the consumer is king. His whim makes and unmakes manufacturers, jobbers, and retailers. Whoever wins his confidence wins the game. Whoever loses it is lost.

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## THE DEVELOPMENT OF A MARKET NEWS SERVICE.

By WELLS A. SHERMAN,

*Specialist in Market Surveys, United States Department of Agriculture.*

May I preface the remarks which will be offered on this subject with the suggestion that need of accurate knowledge of values is as old as the human race? In fact, we are taught that ignorance of food values precipitated the first tragedy in human history. The earliest horticulturist of whom we have any record is reputed to have possessed a garden unrivaled in its beauty and productiveness, but he lost it all, suffered financial and moral bankruptcy, and was dispossessed because he invested unwisely in a promising new fruit. The fact that his partner urged him to go into this ruinous venture proves that ignorance of true market values was well-nigh universal at that period. This pair secured an absolute monopoly of the product in which they speculated, but they furnish incontrovertible evidence that even monopolistic advantages may be purchased at too high a price.

Their children, reduced to poverty through their parents' ignorance or lack of judgment, have spent the ages which have intervened since that sad incident in striving so to buy and sell that each might secure a profit for himself, irrespective of his brother's welfare. Each has guarded as precious secrets his knowledge of the sources of wealth, his knowledge of values, and his knowledge of the market. To make public information which he could use to his own business advantage has been farthest from his thought.

The story of the one completely successful corner in the grain market, which was seven years in developing and which held good for seven more, is familar to us all, but possibly we have not analyzed the economics and the business organization of that situation as its importance would justify. Have we realized the full significance of the fact that the man of immovable moral courage and irreproachable private life, who combined in so rare a degree the statistician, the executive, the politician, and the financier, did not divulge his plan of campaign to the public until after he had secured the financial backing of the only power at once capable of putting his plan into execution and of crushing all business rivals?

May I emphasize the fact that during the 14 years that the Egyptian Government was actively engaged in the grain business under the direction of the patriarch Joseph, a most efficient market news service was maintained, but under such conditions, that its benefits redounded to the seller exclusively?

During the seven years of plenty it was widely known that the Government stood ready to take all the grain not absolutely needed for current consumption. Probably no student of modern business organization or of price statistics will doubt that food prices must have been maintained at high levels under such market conditions. With a buyer of unlimited absorbing power, seeking to acquire for cash as much as possible of each succeeding crop, the price to the populace must have approached the limit of their ability to pay. The transportation facilities offered by the Nile brought the Government offer home to the remotest purchaser. It was virtually an f. o. b. price at point of origin which Joseph quoted.

Who can doubt that the economic condition of the consuming masses brought about by the maintenance of speculative prices during the seven years of hoarding was a most potent factor in so emphasizing the distress which followed in the years of scarcity that the populace was compelled not only to sacrifice all its tangible property, but finally to sell itself into absolute slavery for food.

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The people went into slavery when face to face with starvation, hoping that the Government would feed them for their labor, although as freemen they could not earn enough to buy grain at the Government's quotation. We are prone to complain of unstable and fluctuating food prices. We think it a hardship that prices rise and fall in response to causes which are not evident to the consumer and of which he has no means of informing himself, but I fancy that during those years a little fluctuation in food prices would have been hailed as a blessing. Quotations were only too uniform, unvarying, and authoritative.

Thus we learn not only that the first dire calamity to the race resulted from an insufficient knowledge of values, but that the common people of a great and prosperous nation were brought to ruin and to slavery through the operation of a marketing agency supplied with ample funds and an information service which was absolutely accurate and comprehensive. This marketing agency enjoyed the benefit of a crop-forecast service which stands unique and unrivaled in its perfection, but this merely emphasizes the fact that all market news may be most distressing when it is most accurate and authoritative, and that it is better to have no information than to be supplied with the most accurate information if this is enjoyed by one side of the market only or emanates exclusively from interested sources.

It must be admitted that the monopoly behind the news service was the real factor of danger. A point to be emphasized in this connection is that information on markets and on supply and demand has seldom, if ever, been made public as a purely disinterested service, and that the first governmental activity in this field was on behalf of a governmental monopoly—not as an aid to free and untrammeled private enterprise.

### SOURCES OF INFORMATION.

To-day all information concerning supply and demand, which is accumulated or published by private agencies is viewed with suspicion by the public. It is almost certain that such agencies are financially interested in the products or the markets concerning which their information is compiled. It is very difficult for those engaged in business to make statements concerning their own affairs which are not colored by their interests.

On the other hand, information secured through official agencies has been so slowly acquired and disseminated that it usually is of comparatively little value to the producer, who is confronted with the necessity of realizing quickly on his crop. It is probably for these reasons that the activities of modern governments in accumulating and publishing statistics on supply and demand have been confined largely to the staple crops.

Every civilized Government recognizes the need of world-wide information concerning the potential supply of bread, as reflected in the acreage, condition, and yield of the cereal crops. The establishment of the International Institute of Agriculture at Rome was a recognition on the part of all the nations there represented that both those having grain to sell and those under the necessity of purchasing are benefited by an interchange of information concerning prospective supplies. Such information is invaluable in forecasting the probable movement of breadstuffs in the general commerce of the world, but the information concerning each country must be secured and disseminated by a local agency within that country and through machinery which can be made to move more quickly, if it is to be of service to the average producer in the prompt and intelligent disposition of his individual crop.

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Such price information concerning the cereal crops as is now available originates principally in the various grain exchanges. An active demand on the part of export buyers or millers is felt immediately on the exchanges, where quotations fall and rise in sympathy with these and other influences. The exchange quotations are in turn distributed telegraphically to every grain center in the world. In this country they form, in a general way, the basis for the great bulk of small spot transactions; that is to say, most of the sales of individual crops are based rather definitely upon the prices prevailing on one of the great grain exchanges.

Such a system of price quotations, and of buying and selling based upon those quotations, is possible only in the case of staples, or of products which can be bought and sold upon fixed grades or definite description for future delivery. Within certain limits they answer a useful purpose. There is no reason to doubt that the publication of official statistics and forecasts of grain production and the system of buying and selling for future delivery have together tended to stabilize grain prices. This insures to the man who must sell at harvest a price which more nearly approximates the average price of the year than he would be able to get if such information on supply and prices was not made public.

It is probably fair to say that the market news concerning cereal crops which is now available is in the main derived from official sources in so far as present and prospective supplies are concerned, while practically all market price information is derived from private sources and disseminated by private or business agencies.

### DIFFERENCE BETWEEN STAPLES AND PERISHABLES.

In the United States the producers of fruit and vegetable crops have been heavy sufferers because of the tremendous fluctuations in prices of these products from year to year and within short periods in the same season. Improved methods of transportation have stimulated the production of many perishable crops at great distances from the principal points of consumption, so that the aggregate movement of these products exceeds in market value the merchantable surplus of several of the staples.

These fruits and vegetables must be disposed of immediately after they are harvested. Many of them can not be held upon the farm for 24 hours without very serious deterioration. This means that they must start upon their journey to market as soon as they come from the field. The producer has little time in which to choose between the various markets which may be within reach. He must decide upon a destination and start his car immediately. The railroads grant certain diversion privileges which permit a shipper to choose between a number of markets for a limited time after his products have begun their journey. But it is probable that the final destinations of a vast majority of the carloads of the more highly perishable products, such as strawberries, are determined within 24 hours after the fruit is gathered.

This shows how great is the need of the fruit or vegetable producer for information on market conditions in a number of different cities at the very last hour within which the destination of a shipment remains under his control. To emphasize this fact it is only necessary to remember that a congestion of any of these products at any one market may result in disastrously low prices, while markets which could have been as easily reached are receiving relatively small supplies which are bringing satisfactory prices. A tremendous oversupply in one market, attended by ruinous prices, may be followed in less than a week by a scarcity in that market, accompanied by relatively high prices. In fact, such conditions are bound to obtain if shippers as a class do not have

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definite, accurate, and timely information, not only as to the conditions existing in a large number of markets at the same time, but as to the shipments likely to reach those markets at the same time as their own.

### PRIVATE SOURCES OF INFORMATION.

Until within the past season such machinery as has existed in the United States for accumulating and distributing market data concerning perishable crops has been built up by the wholesale distributing agencies on the one hand and organizations of producers on the other. Trade papers may in general be said to represent the interests of the dealers. Practically all the information heretofore published concerning supplies and prices in the principal markets has been accumulated from, by, and in the interest of "the trade," this term including in a general way all those handlers of the products between the producer and consumer.

The stronger and more successful producers' organizations have endeavored to improve conditions by an exchange of information among their members to assist in the distribution of their products, or by control of the distribution through the organization itself. Some of these associations have been able to place their own representatives in certain of the principal markets to secure disinterested reports, but in the main they have been compelled to rely upon such price quotations as were furnished by the particular commission merchants or brokers in each city with whom they elected to do business.

### GROWTH OF F. O. B. SALES.

The dissatisfaction of shippers with such price quotations as were available, and the danger that prices prevailing to-day in any one market may be wholly demoralized by the receipt of unexpected supplies before the consignment based on to-day's quotations can reach the market has resulted in a widespread effort on the part of growers to sell everything possible on an f. o. b. shipping point basis. Marketing conditions have been so uncertain that many of the best business men among the producers, including the managers of their organizations, have considered it too much of a gamble to start their cars on a journey of 1,000 miles to market without any guarantee that their shipments can be sold for anything more than freight charges on arrival. Responding to this desire to sell f. o. b. shipping point, many of the larger dealers and distributing concerns have put buyers in the field who are supplied with the very best market information which it is possible for the interests they represent to obtain. These buyers have a direct interest in withholding from the producers with whom they deal any information which would encourage the shipment of products unsold. This results in a situation in which the producers of a given territory may be conducting daily transactions with men who have intimate knowledge of conditions on many markets which the producers can not obtain but which would be of great value to them. On the other hand, the buyer is handicapped and frequently unable to offer the best prices which his advices would justify, because of the uncertainty as to the quantity of the particular product which will come upon the market in competition with his own from other shipping areas in which his particular firm may not be represented.

This indicates that a private news service for perishable products can be successful only when these products are produced within well-defined and limited areas which can be definitely covered by representatives of this agency. The outlets for these products must also be limited, for the number of markets

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which a private agency can cover comprehensively is limited. It is quite evident that where products are moved over great distances to a large number of markets and where many widely separated producing areas are shipping at the same time, no one private agency can meet the situation without at the same time acquiring such power as to make it a menace to the public welfare.

### SHIPPING DATA ESSENTIAL.

One essential of a satisfactory news service must be withheld from any private agency as long as the common carriers—railroad, boat, and express companies—are under any measure of governmental supervision or control. These carriers can never be allowed to furnish to private interests the facts concerning shipments made by business rivals. Accurate and prompt reports of crop movement are the first requisite of a successful and useful news service for perishables. To assemble and publish such information is no part of the duty of the common carriers. Recognition of this fact, and of the fact already cited that all price information heretofore published has been gathered by private enterprise and chiefly by persons or agencies having business interests at stake which might be served by coloring price quotations, has prompted the Department of Agriculture to test the practicability of a comprehensive market news service specially designed to meet the needs of all those legitimately interested in the fruit and vegetable industry.

### METHODS OF PROCEDURE.

It was recognized in the beginning that any news service for perishables, in order to meet the demands of the situation, must be based upon telegraphic communication between the central agency and the producing areas on the one hand and the markets on the other. The first step was the selection of a number of products which would come upon the market in succession so that the machinery set up might be kept in operation throughout the summer and might be tested by crops moving over short and long distances and over every important transportation line in the country. For this purpose strawberries, tomatoes, peaches, and cantaloupes were chosen.

The next step was to locate as definitely as possible those areas from which important carload shipments of these commodities were likely to be made.

The third step was to secure from the transportation companies on whose lines these shipments would originate daily telegraphic reports of the number of cars shipped from each important producing area with their destinations.

Fourth, to arrange with reliable persons on each of the important markets for telegraphic reports each morning of the arrivals of the particular product in that market, the prices prevailing, the quality, weather, and other variable factors influencing the price.

The organization of an office force in Washington for handling separately and simultaneously the telegraphic reports received from the carriers on the one hand, and the markets on the other, may be considered the fifth step.

Sixth, we placed a representative of the department, or selected some disinterested individual, in each important shipping district to whom a summary of all telepraphic information received in Washington could be transmitted for prompt dissemination among the growers and buyers in that district.

To give the service its greatest usefulness a seventh step was found necessary, involving an arrangement in each of the larger markets with some official agency through which the summary of telegraphic information could be distributed impartially to the trade and placed at the disposal of the press.

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The experience of one season indicates that each of these steps or agencies is an essential factor in the development of a thoroughly satisfactory service.

The exact method by which each of these objects is to be accomplished involves the experimental working out of an immense amount of detail. It has been believed that all telegraphic information received in Washington should be considered public, practically from the moment it is summarized. Acting upon this theory the department has transmitted the facts in its possession, in whole or in part, by telegraph, collect, to all applicants.

It has been found most effective and desirable to place a representative of the department, who has some technical knowledge of the product, in each of the principal producing areas, whose business it is to see that the telegraphic market news is placed at the disposal of every legitimate interest. Neither the producers nor the buyers could be expected to accept the information offered as of immediate and substantial commercial value until its accuracy and impartiality was brought home to them by daily discussion and analysis. So far as the producing areas are concerned this service has been found to supplement most effectively such information as it has been possible for the average local organization of producers to secure for itself.

The service has been welcomed by every such organization, and several of them, located where we have not been able to place representatives, have paid heavy telegraph tolls for the sake of securing impartial information on certain markets with which they were not in close touch, and especially that they might be advised of the shipments from competing territory and the destination of those shipments.

On the other hand, the securing of accurate and impartial information from the markets has presented a very different problem. A number of possible methods have been tried. Among these are the selection of an important handler of the product in question in each city with whom an arrangement could be made to furnish this department the desired information according to the best judgment of the firm itself. This arrangement is unsatisfactory because no matter how high the character of the selected firm may be, some other house of good reputation may disagree with the average prices as reported.

Furthermore, no private agency in a large city can secure with accuracy a record of the number of cars unloaded within the preceding twenty-four hours. Nor can this department be certain that the same person in the firm will assemble and forward the information each day, or, if so, that he will be able to give it the same conscientious and accurate attention in all cases. Again, the press of business will sometimes necessitate neglecting this voluntary report, and the department can not insist that a service of courtesy be rendered at a specific hour. Occasionally the report will be overlooked entirely or sent in too late to be of service. Because of these and other weaknesses it has been decided that the voluntary assistance of the trade, no matter how well-meaning, can not be relied upon to furnish the market information which must be had to give an official news service its greatest value.

A modification of this method has been tried by the employment of a clerk or other person, not financially interested in the produce trade, whose business it has been to call upon a selected list of dealers for the information desired, average their estimates, and telegraph the result to Washington. By employing persons who have other regular occupations which they must undertake by 8 or 9 a. m., the department secures the desired promptness in the filing of reports and comparative uniformity in the hour of their dispatch. Its position is, however, little better than that of the trade newspapers as to the accuracy of the reports received, and the department has not sufficiently close supervision

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of such part-time employees as to make it certain that their duties are effectively and conscientiously performed. Again, there is always danger that interested parties in the trade, for business reasons, may mislead an employee who is not himself familiar with the technique of the market.

The third and only thoroughly satisfactory system is the establishment of branch offices in the markets from which reports are desired, in charge of our own men who have a technical experience in the wholesale fruit and produce business. These men, as disinterested representatives of the Government, can secure from every transportation line entering the city a daily, authoritative report of the number of cars received and unloaded, and through their own knowledge of market conditions can cultivate those relations of friendship and good will which are essential to satisfactory dealing with the wholesale and jobbing trade.

By transmitting to these representatives the summaries of shipments from all producing areas, a general résumé of f. o. b. prices asked and received in the producing districts, we enable them to dispense to the trade information of the utmost value to its most prominent and influenial members. Through these representatives the trade can obtain authoritative information hours before it can be given to the public through the newspapers, and during the experimental work of a single season it has been found possible to furnish almost every private agency in the country which is interested in the handling of any of the products reported with information more comprehensive and authoritative than it was able to secure through its own organization.

Since all the railroads of the United States are under private ownership, the department has been dependent upon their cooperation to secure the success of this undertaking. Responsible officials must give time and attention daily to make the necessary telegraphic reports. A campaign of education has been necessary to show to the carriers that the advantages to be derived by the shippers and themselves warranted the expenditure of effort for which we have felt compelled to ask them. They have generally recognized, however, that any system which enabled their shippers to determine at the earliest possible moment the final destination of their cars, thus avoiding frequent and needless diversions of cars in transit, is distinctly to their advantage. Any information on market prices which will result in more profitable returns to their shippers and the further development of the fruit and trucking interests is also recognized as distinctly to the advantage of the carrier. Claim departments of certain roads have also welcomed our price quotations as the most authoritative basis upon which to determine the value of perishable products at the exact time when injuries or losses in transit have occurred.

Of course, in so far as any government directly owns or operates its transportation systems or its means of telegraphic or telephonic communication, its problem in the inauguration of such a service as we have undertaken is simplified.

Two facts have enabled the department in a single season to organize a service more comprehensive and useful than could be developed by any private agency for the same products. First, it has secured the cooperation of all the carriers in furnishing telegraphic reports of shipments. Second, by arrangement with the telegraph companies all Government business receives preferential treatment. This fact has enabled us to assemble in Washington telegraphic reports from the principal markets; digest, combine, and rewire them to important shipping areas with greater promptness than buyers in these areas could secure the same information through their employers' offices.

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## A PRACTICAL MARKET SYSTEM FOR OUR LARGE CITIES.

By G. V. BRANCH,

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A vigilant search among our cities reveals nothing that can be characterized as a model marketing system for the urban distribution of perishable farm products. There seem to be model parks, boulevards, zoological gardens, municipal buildings, street railway systems, and electric plants of which the possessors are proud, but when it comes to pointing out a city which by the joint expenditure of brains and money has secured a practical working plan to insure the quick and effective handling of the fresh food products designed to feed its people, we are forced to agree with the verdict of the rurally-raised gentleman who, upon looking at a giraffe in the park, decreed that "there are no sich animal." This statement might be enlarged to include the cities of other countries as well, for none of them have solved the question to their satisfaction.

In the process of developing from a village, which is supplied to a great extent by local production, into a large city, the problem of feeding the people cheaply and well seems in most cases to have been forgotten in the excitement of growth. When an awakening comes as the result of high prices for food, the whole matter of distribution and marketing within the city has assumed such large proportions and the necessary remedy would be so expensive that only half-hearted attempts are made to correct conditions in a thorough-going way. However, a discussion of this nature need not be entirely theoretical because of the lack of a complete working model to refer to, for while no one city has mastered all of the problem, various cities have solved different parts of it in a fairly satisfactory way, and their institutions serve well as a guide.

In the study of marketing it has become almost an axiom that if prices to the consumer are to be lowered and the returns to the grower increased, the necessary savings must come from the elimination of waste so far as possible—waste of material, money, time, and effort, as well as waste resulting from inefficiency. Consequently, the problem of designing a practical market system for our larger cities is one which calls for the application of efficient engineering principles as well as those of good marketing practice.

As in all business ventures of importance, the man in charge is of greater consequence than any other factor. A city which now has, or is contemplating establishing, a municipal marketing system needs to secure as a leader in the work a thoroughly competent man—one who understands the practical side of the problems to be worked out but who has not lost his daring or breadth of vision through a knowledge of the difficulties to be overcome. When such a man is obtained, he should be given the necessary financial and managerial power, unhampered by political or other factional influence, to accomplish successfully the task assigned to him. The foregoing discussion of the need for high-class managing officials may sound redundant in view of the world's universal demand for men of caliber, but so many cities have either ruined or greatly decreased the efficiency of their marketing work by placing it under the direction of incompetent men that the matter demands special emphasis whenever the subject of municipally-owned markets is dealt with.

The discussion of a system for the intraurban marketing and distribution of farm products naturally resolves itself into a treatment of the facilities for the reception of these products and for their sale through wholesale and retail channels. The centralization of a city's incoming foodstuffs is generally con-

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ceded to be a matter of prime importance and no more efficient institution for this purpose has been designed than the wholesale terminal market. Since distribution, and not concentration of food products, is the aim of the work under discussion, some students of the subject contend that smaller wholesale receiving and distributing stations located in different sections of the city is the right method of procedure. Theoretically, this idea appears logical, and the future may show its practicability, but at present its disadvantages are so apparent that those engaged in the fruit and produce business almost unanimously voice the demand for one union terminal where the business will be brought together. The feasibility of such a plan becomes more evident when its points of superiority are taken into consideration.

A terminal market, where the perishable food supply of a city can be received and distributed in a wholesale way, establishes a trading center where all buyers and sellers are brought together, thereby tending to create ideal conditions for competitive bargaining and for the establishment of fair prices. Like a large department store, such a market place attracts trade through the extensive assortment of products offered, and the convenience of being able to secure quickly, and in one locality, the supplies desired. A properly constructed terminal market greatly reduces the overhead expenses of the wholesaler by eliminating much of the necessity of drayage and by lessening his outlay for salesmanship and carlot inspection. Instead of having his store in one section of the city and his daily carlot receipts of fruits and produce scattered in probably half a dozen different railroad yards, his business is consolidated at one point where the volume of buying trade is at a maximum. With a large percentage of the daily offerings delivered to the buying jobber or the retailer from the car door or over the warehouse platform, the handling and the deterioration of the articles is reduced to a minimum. The reshipping of products to out-of-town trade is facilitated, and the cold storage of carloads and parts of carloads is made possible without delay or inconvenience. As an aid in bringing about better sanitary and health inspection service, and in enforcing other municipal, State, or national regulations, the centralization of the incoming food supply of the city naturally is most desirable.

In certain very large cities like Greater New York, which is virtually a combination of several municipalities geographically separated to some extent, doubtless too great a concentration of the fruit and produce business can be developed. However, present conditions in New York illustrate well the drawing power of a large central market, because the trade from miles around will pass smaller wholesale centers to secure the advantages of buying at the piers.

In its model form, a wholesale terminal market should consist of several sections. Many products can be handled very satisfactorily from the car door directly into the wagon or truck of the buying jobber or large retailer. Therefore, a well-designed and sanitarily-constructed track market space, capable of accommodating the required number of cars, is very desirable, provided that it is so regulated that undue delay is not caused in the unloading of cars, and irresponsible speculators are not permitted to operate to the detriment of the business in general. This track market should be supplemented with adequate warehouse space where cars placed on one side can be unloaded to the platforms and the contents distributed to the buyers' wagons which are backed up on the opposite side. Such platform space should be subdivided and rented to the wholesale and commission merchants. Thus by selling from the car door on the track market, and from his space on the warehouse platform, it is necessary for a dealer to haul but a comparatively small amount of goods to his store, and a substantial saving in cartage charges and injury



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to products is effected. As a part of the warehouse system, display and sales rooms for the auction method of selling ought to be provided, while on one section of the market it is advisable to construct a series of storerooms and offices to accommodate the firms which desire such facilities. A wholesale terminal market would be deficient indeed if it were not provided with cold storage space. Not only does the storage building need to be equipped to receive and handle car-lot consignments conveniently, but if possible, it should be so connected with the sales warehouses and merchants' stores that small unsold quantities of fruits and vegetables can be transferred readily to the refrigerators if desired. The problem of reshipping ought not to be overlooked, and the design of the market ought to include facilities that will handle the outgoing business in an efficient way.

This rough sketch of a produce terminal does not include accommodations for the marketing of produce grown nearby, most of which is brought into the city by team, automobile truck, and interurban trolley. For the good of all concerned, however, the wholesale farmers' market should form a part of the terminal plan. This not only allows the local grower to come in contact with the buying trade of the city, but, when the local market is glutted with home-grown products, it provides convenient facilities for assembling and shipping car lots of produce to better markets.

It is very evident that the value of a terminal market depends to a large extent upon the transportation facilities with which it is connected. In fact, the proper location of such a market is almost entirely dependent upon the transportation factor. If a city is located upon navigable water, every effort ought to be made to place the market so that it will have the benefit of both rail and boat connections. The more central the location is the better, but this factor ought not outrank that of nearness to transportation facilities when the location for a market is being sought. It is imperative that a municipal terminal market project be open on the same basis to all railroads, both electric and steam. A belt line cutting all the transportation lines entering a city and serving them all under identical conditions makes, of course, the ideal rail connection for any market to possess. If the market must be located on a trunk line, however, precaution should be taken to see that the working agreements do not discriminate in favor of any one company.

With the incoming perishable food supply for a city assembled at one point where it receives the most efficient handling, the problem of getting it to the consumer is still but partly solved. As a matter of fact, economical retail distribution of perishable products is infinitely more difficult to bring about than are improvements in the wholesale intraurban marketing system. Practically all investigational efforts along this line point out the fact that the greatest weakness in the present marketing system lies in its apparent inability to effect a maximum retail distribution at a moderate cost. The gross profit of the retailer on many perishable articles often is greater than the sum of all preceding gains which dealers have made on those products. Very frequently it exceeds the amount which the grower receives for producing the article, and often it is found to surpass the total amount of all previous charges, including that of the grower, the transportation company, and the various middlemen involved; in other words, the retailer often adds a gross profit of more than 100 per cent. Still grocers do not get rich, and this business records more failures than any other. The fault is not that the retailer secures too great a net profit, but rather that his overhead expenses are too high, and that on the average his business is conducted in so inefficient a manner. He is confronted with the demands of the consumer for expensive credit and delivery service;

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he faces the high percentage of spoilation in the green-goods business, and, unless he is an unusually careful buyer, he must take poorly graded products of mediocre quality from the grower. These troubles seem to baffle him, so he drifts along under the old system of charging a high margin of profit to cover his heavy expenses, thereby causing a decrease in the demand for perishable products which necessarily retards their movement and causes more loss. Another seemingly fundamental defect lies in the fact that the average retailer operates on a credit-delivered price basis instead of quoting a cash price for his goods at the store and charging for the credit and delivery service. As a rule, the person who pays cash for the goods and carries them home receives less consideration than the credit customer and pays the same price.

These conditions seem to be sufficient justification for the municipality to enter the field for the purpose of helping both the consumers and the retailers. Well-designed and well-managed municipal retail markets can be of great value in facilitating the distribution of perishable products, if the city will but undertake the business with sincere purpose and determination. Once more let it be said that on the man who is put in charge of the markets will depend their success or failure.

Without doubt the most desirable type of municipal retail market at the present time is a combination of an inclosed building for the sale of meats, fish, dairy products, and other fresh foodstuffs which need protection, supplemented by an open or shedded space for the use of farmers who desire to sell direct to the people. Whether such open space should be rented also to hucksters who are not producers is largely a matter for local decision.

Since the aim of this discussion is to outline a "practical" system of city distribution, no attempt will be made to discuss the theoretical ideas that are frequently advanced to the effect that municipalities should enter into the actual buying and selling of products in a public market. These suggestions may prove their value in the future, but at present the generally approved plan is for the city to afford first-class facilities at a low cost, so that both the producers and the middlemen can carry on the business of retail distribution at a minimum overhead expense. The city further should aim to regulate this business carried on within its property so that the buying public will share proportionately in the savings.

Unless a municipal retail market is so conducted that substantial advantages result to the consumer, directly or indirectly, then there certainly can be no justification for the maintenance of the project by the city. The mission of a public market might be summarized roughly as follows:

It should offer to the buying public a large assortment of fresh foodstuffs under attractive and sanitary conditions.

It should cater to the buyer who desires to pay cash for goods and carry them home, or who has them delivered at his own expense, by charging for the goods only and not for credit and delivery service which he neither wants nor uses.

The public ought also to share in the savings which the dealer effects in receiving his stall and equipment at a low cost and in being able to meet with the large volume of potential trade which comes to the market.

It should act in a measure as a retail price governor throughout the city and also serve to educate people regarding better buying methods.

In the establishment of a municipal retail market the factor of location is all-important. Probably more markets have failed because they were placed on inaccessible or unattractive sites than for any other reason. The market must be situated as near the heart of the shopping district as possible. In the

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larger cities additional ones may be located advantageously in subsidiary business centers, but this should be done only after it is ascertained that there will be sufficient patronage in each section to support the institution properly. Berlin endeavored to solve its retail problem by placing markets in various parts of the city, but without great success. Too many housewives passed them by in order to shop at the large central market downtown where the products were fresher and in greater assortment.

Sanitary buildings and a healthy "farmers' line" are very essential features in connection with a public retail market and neither should be overlooked in making plans for an establishment of such a nature.

When a city has a good wholesale terminal market to handle adequately and economically the reception and primary distribution of its perishable food supply, and likewise has developed satisfactory retail market places, there remains at least one more problem to be worked out, namely, the most efficient means of transportation between the two. At present this is taken care of almost entirely by wagon and auto truck, but there are reasons to believe that cheaper and quicker service eventually will be secured by the use of interurban and city trolley systems as package-freight carriers during the earlier morning hours. Switches along the receiving platforms of retail public markets and near jobbing districts throughout a city would enable cars from the wholesale terminal or produce district to be unloaded without interfering with other traffic. When cities exert the same effort in perfecting the handling of their food supply that they do in perfecting other civic institutions many improvements of this nature are bound to result.

One is naturally impressed with the estimated total cost of a municipal marketing system such as has been outlined. There is no doubt that the initial expense would be high, as is generally the case with institutions that are both efficient and large. However, if properly worked out and placed under the direction of competent officials the whole system could be made not only self-supporting, but sufficient funds could be derived, even from low rentals, to slowly retire the bonds issued to establish the enterprise. This assertion is not given at random, but is made on the strength of information received from the scores of cities that have public markets of some type. This knowledge should encourage our larger municipalities to undertake the improvement of their marketing and distributing systems and to spare no effort in finding a remedy for the unsatisfactory conditions which so commonly exist.

## DEVELOPING FOREIGN MARKETS FOR APPLES.

By CLARENCE W. MOOMAW,

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The subject of developing foreign markets for apples is of interest chiefly to the fruit producers and shippers of the United States and Canada, because in recent years the development of the fruit industry and the increasingly large output has taxed their utmost resources in making profitable disposition of the crops.

Both in the States and the Dominion there has been much distress among fruit growers owing to unprofitable returns, and there is evidence of great unrest among them as to the marketing systems which are now employed. In

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many sections cooperative organization has been undertaken in a large way, and the producers turn to foreign lands with the hope of finding beyond our shores an outlet for such a portion of the crops as may relieve the tension in the domestic markets and assure a reasonable profit on their orchard investments.

To the visitors from other Pan American countries it may be stated that during the past few years a special effort has been made by the shippers of the United States to increase their trade in fruit products with Latin America, and since the production of apples in those countries is not equal to the demand, their representatives naturally may be interested in the subject as the consumers of this fruit.

The wholesome qualities of the apple commend it as an aid to health, and the several hundred ways in which the fruit may be prepared for consumption make of it a delicious food product. In the United States there is a saying to the effect that "an apple a day keeps the doctor away," so it is believed that efforts to make apples available to the people of Latin America are a benefit to them as well as to us.

The chief undertaking in developing markets for a commodity is to deliver the product at a price that will insure liberal consumption. In developing foreign markets for apples all of the efforts of growers and shippers must be so directed as to bring about a reduction in the cost of American apples to foreign consumers.

A nation's ability to buy of other nations is proportionate to its ability to sell. This is the foundation of international trade relations. Apples are among the commodities which the people of the United States produce in excess of their own demands, and the surplus represents something with which to buy such products as may not or can not be produced here. An increase in the trade of the United States in apples with the other countries of Pan America signifies an increase in imports from those countries.

Furthermore, liberal shipments of apples to our neighbors will aid in creating shipping facilities for the products which they may have for export to the United States. This may be illustrated by saying that special facilities in the way of refrigerator chambers aboard steamers and cold storages at seaboard are required for the development of Argentina's trade with the United States in meat products. If such facilities are to be used only for handling that country's export trade in meats, the overhead costs of operation would require rates of storage and transportation which might prove to be prohibitive. Therefore, if a commodity can be supplied in exchange so that these facilities may be used by both countries, it is likely that such facilities may improve and that rates may become more reasonable.

The cold-storages and refrigerator chambers aboard steamers can be utilized by increasing the exportation of fruit products from the United States to the South American countries. The last few years have shown rapid development in the shipments of apples from the United States to its neighbors in Pan America. The increase has been especially noticeable in the case of Argentina, and this increase has occurred by reason of the refrigeration which may be secured. So, in time, through the exchange of North American apples for South American meat or other perishable products, shipping facilities may be expected to improve rapidly.

The suggestions which are to be given regarding the development of foreign markets for apples may be considered as pertinent to the exportation of all fresh and preserved fruit products, and so it is possible that those countries which do not produce apples in large quantities may derive aid in the marketing of such other fruits as they may grow for export trade.

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Accordingly it is hoped that the subject may be of interest to the representatives of Pan America in attendance upon this congress, although it relates primarily to the development of markets for a product which is grown almost exclusively in North America as far as the Western Hemisphere is concerned.

### THE STATUS OF TRADE IN APPLES BETWEEN THE UNITED STATES AND FOREIGN COUNTRIES.

In order to know the extent to which foreign markets have been developed for apples grown in the United States, and the chief countries with which this trade has been carried on, there is given a statement of the total quantity and value of the fresh and dried apples exported annually from 1851 to 1914, inclusive, and a statement of the distribution of exports during 1910, 1911, 1912, 1913, and 1914.

*Quantity and value of fresh and dried apples exported from United States since 1851.*

| Year ending June 30— | Apples. | | | |
|---|---|---|---|---|
| | Dried. | | Fresh. | |
| | *Pounds.* | *Dollars.* | *Barrels.*[1] | *Dollars.* |
| 1851 | ..... | ..... | 28,842 | 71,367 |
| 1852 | ..... | ..... | 18,411 | 43,635 |
| 1853 | ..... | ..... | 45,075 | 107,283 |
| 1854 | ..... | ..... | 15,326 | 51,766 |
| 1855 | ..... | ..... | 33,959 | 107,643 |
| 1856 | ..... | ..... | 74,287 | 143,884 |
| 1857 | ..... | ..... | 33,201 | 135,280 |
| 1858 | ..... | ..... | 27,711 | 74,363 |
| 1859 | ..... | ..... | 32,979 | 99,803 |
| 1860 | ..... | ..... | 78,809 | 206,055 |
| 1861 | ..... | ..... | 112,523 | 269,363 |
| 1862 | ..... | ..... | 66,767 | 238,923 |
| 1863 | ..... | ..... | 174,502 | 364,628 |
| 1864 | 2,841,532 | 246,051 | 183,969 | 487,140 |
| 1865 | 892,075 | 105,548 | 120,317 | 431,334 |
| 1866 | 551,350 | 55,265 | 51,612 | 246,118 |
| 1867 | 510,750 | 79,922 | 29,577 | 142,023 |
| 1868 | 775,700 | 121,910 | 19,874 | 94,748 |
| 1869 | (2) | (2) | (2) | (2) |
| 1870 | 836,110 | 79,387 | 36,157 | 230,013 |
| 1871 | 1,150,122 | 79,026 | 49,068 | 136,693 |
| 1872 | 2,644,592 | 190,560 | 36,508 | 196,948 |
| 1873 | 4,483,186 | 272,028 | 241,663 | 819,664 |
| 1874 | 4,234,736 | 294,393 | 44,928 | 204,312 |
| 1875 | 4,053,696 | 326,193 | 276,209 | 722,247 |
| 1876 | 713,340 | 67,915 | 64,472 | 221,764 |
| 1877 | 14,318,052 | 920,292 | 417,065 | 986,112 |
| 1878 | 4,188,173 | 260,085 | 101,617 | 386,261 |
| 1879 | 7,379,836 | 296,794 | 505,018 | 980,455 |
| 1880 | 3,158,367 | 192,069 | 407,911 | 1,190,560 |
| 1881 | 22,623,652 | 1,247,891 | 1,117,065 | 2,301,334 |
| 1882 | 2,893,270 | 228,945 | 176,704 | 539,543 |
| 1883 | 10,187,957 | 786,800 | 313,921 | 1,085,230 |
| 1884 | 5,558,746 | 394,350 | 105,400 | 422,447 |
| 1885 | 18,416,573 | 1,062,859 | 668,867 | 1,572,126 |
| 1886 | 10,473,183 | 548,434 | 744,539 | 1,810,606 |
| 1887 | 8,130,396 | 413,363 | 591,868 | 1,382,872 |
| 1888 | 11,803,161 | 812,682 | 489,570 | 1,378,801 |
| 1889 | 22,102,579 | 1,201,070 | 942,406 | 2,249,375 |
| 1890 | 20,861,462 | 1,038,682 | 453,506 | 1,231,436 |
| 1891 | 6,973,168 | 409,605 | 135,207 | 476,897 |
| 1892 | 26,042,063 | 1,288,102 | 938,743 | 2,407,956 |
| 1893 | 7,966,319 | 482,085 | 408,014 | 1,097,967 |
| 1894 | 2,846,645 | 168,054 | 78,580 | 242,617 |
| 1895 | 7,085,946 | 461,214 | 818,711 | 1,954,318 |
| 1896 | 26,691,963 | 1,340,507 | 360,002 | 930,289 |
| 1897 | 30,775,401 | 1,340,159 | 1,503,981 | 2,371,142 |
| 1898 | 31,031,254 | 1,897,725 | 606,390 | 1,684,717 |
| 1899 | 19,305,739 | 1,245,733 | 380,222 | 1,210,459 |

[1] For 1866–1868 and 1870–1883, computed by converting bushels into barrels at the rate of 2½ bushels to 1 barrel.
[2] Not stated.
[3] Not separately stated.

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*Quantity and value of fresh and dried apples exported from United States since 1851—* Continued.

| Year ending June 30— | Apples. | | | |
|---|---|---|---|---|
| | Dried. | | Fresh. | |
| | *Pounds.* | *Dollars.* | *Barrels.* | *Dollars.* |
| 1900 | 34,964,010 | 2,247,851 | 526,636 | 1,444,655 |
| 1901 | 28,309,023 | 1,510,581 | 883,673 | 2,058,964 |
| 1902 | 15,664,468 | 1,190,593 | 459,719 | 1,628,886 |
| 1903 | 39,646,297 | 2,378,635 | 1,656,129 | 4,381,801 |
| 1904 | 48,301,665 | 2,791,421 | 2,018,262 | 5,446,473 |
| 1905 | 39,272,890 | 2,208,414 | 1,499,942 | 3,859,375 |
| 1906 | 27,852,831 | 2,044,820 | 1,208,989 | 3,751,375 |
| 1907 | 45,697,948 | 3,166,946 | 1,539,267 | 4,652,966 |
| 1908 | 24,237,873 | 1,946,810 | 1,049,545 | 3,660,854 |
| 1909 | 33,474,634 | 2,339,936 | 896,279 | 2,782,007 |
| 1910 | 25,076,618 | 2,056,692 | 922,078 | 3,175,433 |
| 1911 | 21,804,086 | 1,944,209 | 1,721,106 | 5,777,458 |
| 1912 | 53,664,639 | 4,545,971 | 1,456,381 | 5,409,946 |
| 1913 | 41,574,562 | 2,898,211 | 2,150,132 | 7,898,634 |
| 1914 | 33,566,160 | 2,628,445 | 1,506,569 | 6,089,701 |

***Distribution and value of fresh and dried apples exported from the United States in 1910, 1911, 1912, 1913, and 1914.***

| Countries. | Apples, dried. | | Apples, fresh. | |
|---|---|---|---|---|
| Europe: 1910. | *Pounds.* | *Dollars.* | *Barrels.* | *Dollars.* |
| Austria-Hungary | 1,400 | 130 | 6 | 30 |
| Belgium | 1,510,939 | 100,496 | 707 | 3,152 |
| Denmark | 832,933 | 63,024 | 4,569 | 14,732 |
| Finland[1] | | | | |
| France | 104,473 | 8,702 | 255 | 1,236 |
| Germany | 13,646,650 | 1,174,480 | 108,786 | 408,174 |
| Italy | | | 283 | 1,360 |
| Netherlands | 6,430,614 | 519,813 | 1,871 | 8,210 |
| Norway | 215,690 | 16,392 | 2,321 | 8,668 |
| Portugal | 760 | 65 | | |
| Russia in Europe | 110,200 | 7,458 | 143 | 608 |
| Spain | | | 3 | 12 |
| Sweden | 880,620 | 60,692 | 14 | 64 |
| Switzerland | | | 1 | 4 |
| United Kingdom: | | | | |
| England | 476,185 | 32,482 | 569,139 | 1,859,268 |
| Scotland | 126,925 | 7,605 | 77,585 | 295,491 |
| Ireland | | | 2 | 10 |
| Canada | 104,885 | 8,722 | 68,920 | 279,290 |
| Panama | 9,648 | 779 | 6,347 | 29,388 |
| Mexico | 72,323 | 5,837 | 20,899 | 63,054 |
| West Indies: | | | | |
| British— | | | | |
| Barbados | | | | |
| Jamaica | | | | |
| Trinidad and Tobago | 2,311 | 198 | 1,623 | 6,797 |
| Other British | | | | |
| Cuba | 7,862 | 654 | 16,835 | 68,770 |
| Danish | | | 157 | 598 |
| Dutch | | | 92 | 394 |
| French | | | 136 | 571 |
| Haiti | 257 | 22 | 216 | 924 |
| Santo Domingo | 250 | 16 | 411 | 1,724 |
| South America: | | | | |
| Argentina | 52,396 | 5,030 | 580 | 3,162 |
| Brazil | 14,539 | 1,321 | 9,462 | 31,829 |
| Chile | 14,014 | 1,176 | 7 | 30 |
| Colombia | 1,218 | 121 | 205 | 817 |
| Ecuador | 175 | 17 | 12 | 48 |
| Guiana— | | | | |
| British | 102 | 8 | 864 | 3,194 |
| Dutch | 200 | 24 | 580 | 2,365 |
| French | | | 3 | 12 |
| Peru | 1,365 | 152 | | |
| Uruguay | 14,251 | 1,163 | 100 | 505 |
| Venezuela | | | 1,124 | 4,348 |
| The Orient (Asia) | 90,910 | 8,346 | 6,300 | 18,367 |
| Australia | 5,000 | 425 | 3,400 | 11,138 |
| South Africa | 134,514 | 13,523 | | |
| Total[2] | 24,863,609 | 2,038,873 | 903,958 | 3,128,344 |

[1] Included in "Russia in Europe" prior to 1911.

[2] All countries are not shown in this table.

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*Distribution and value of fresh and dried apples exported from the United States in 1910, 1911, 1912, 1913, and 1914*—Continued.

| Countries. | Apples, dried. | | Apples, fresh. | |
|---|---|---|---|---|
| **1911.** | | | | |
| Europe: | *Pounds.* | *Dollars.* | *Barrels.* | *Dollars.* |
| Belgium | 974,335 | 74,371 | 2,325 | 9,424 |
| Denmark | 1,266,949 | 113,580 | 11,959 | 45,045 |
| Finland [1] | 57,096 | 4,216 | 1,165 | 4,100 |
| France | 784,606 | 76,854 | 842 | 4,042 |
| Germany | 10,507,494 | 951,858 | 112,319 | 451,296 |
| Italy | | | 245 | 1,021 |
| Netherlands | 5,244,142 | 463,977 | 937 | 4,710 |
| Norway | 198,416 | 16,856 | 4,914 | 18,404 |
| Portugal | 640 | 73 | 5 | 18 |
| Russia in Europe | 57,715 | 4,564 | 127 | 648 |
| Spain | | | 5 | 20 |
| Sweden | 760,393 | 62,474 | 2,283 | 9,132 |
| United Kingdom: | | | | |
| England | 917,162 | 78,891 | 1,050,264 | 3,346,641 |
| Scotland | 52,800 | 4,702 | 267,830 | 969,812 |
| Ireland | | | 26 | 133 |
| Canada | 266,792 | 22,985 | 155,081 | 502,959 |
| Panama | 29,833 | 2,030 | 8,284 | 44,677 |
| Mexico | 116,620 | 9,436 | 18,539 | 65,852 |
| West Indies: | | | | |
| British— | | | | |
| Barbados | 985 | 122 | 177 | 701 |
| Jamaica | 76 | 8 | 667 | 3,126 |
| Trinidad and Tobago | 272 | 26 | 487 | 1,852 |
| Other British | 32 | 3 | 478 | 2,074 |
| Cuba | 5,600 | 592 | 21,928 | 93,337 |
| Danish | | | 124 | 486 |
| Dutch | 740 | 82 | 134 | 572 |
| French | | | 136 | 521 |
| Haiti | 1,208 | 92 | 275 | 1,288 |
| Santo Domingo | 815 | 71 | 627 | 3,007 |
| South America: | | | | |
| Argentina | 24,576 | 2,593 | 1,180 | 4,330 |
| Bolivia | 360 | 79 | | |
| Brazil | 23,511 | 1,826 | 13,387 | 46,630 |
| Chile | 19,560 | 1,804 | | |
| Colombia | 6,314 | 615 | 535 | 2,573 |
| Ecuador | 400 | 38 | 15 | 44 |
| Guiana— | | | | |
| British | | | 560 | 2,029 |
| Dutch | 500 | 52 | 220 | 1,019 |
| Peru | 3,125 | 335 | | |
| Uruguay | 8,914 | 875 | 305 | 1,270 |
| Venezuela | | | 1,458 | 5,628 |
| The Orient (Asia) | 165,733 | 16,411 | 6,307 | 19,764 |
| Australia | 100 | 9 | 12,230 | 32,896 |
| South Africa | 111,257 | 13,881 | 7 | 30 |
| Egypt | | | 1 | 5 |
| Total [2] | 21,609,071 | 1,926,381 | 1,698,378 | 5,701,116 |
| **1912.** | | | | |
| Europe: | | | | |
| Austria-Hungary | 24,405 | 2,227 | 276 | 977 |
| Azores and Madeira Islands | 19,372 | 1,402 | | |
| Belgium | 3,344,855 | 261,850 | 1,433 | 6,513 |
| Denmark | 1,683,490 | 143,275 | 10,626 | 36,215 |
| Finland [1] | 276,704 | 21,553 | 2 | 6 |
| France | 1,070,173 | 100,352 | 1,421 | 7,880 |
| Germany | 27,598,728 | 2,336,176 | 122,823 | 509,892 |
| Italy | 2,025 | 161 | 68 | 459 |
| Netherlands | 14,396,795 | 1,221,804 | 3,325 | 14,322 |
| Norway | 436,885 | 34,172 | 3,705 | 15,717 |
| Portugal | 6,863 | 662 | | |
| Russia in Europe | 146,015 | 11,218 | 3 | 12 |
| Spain | | | 23 | 95 |
| Sweden | 1,687,765 | 134,888 | 350 | 1,174 |
| Switzerland | | | 25 | 113 |
| United Kingdom: | | | | |
| England | 1,701,737 | 149,197 | 785,558 | 2,797,361 |
| Scotland | 176,144 | 16,313 | 208,981 | 818,906 |
| Ireland | | | 112 | 64 |
| Canada | 281,296 | 27,680 | 206,857 | 736,015 |
| Panama | 10,263 | 1,450 | 11,122 | 45,234 |
| Mexico | 99,156 | 9,543 | 23,799 | 95,210 |

[1] Included in "Russia in Europe" prior to 1911.

[2] All countries are not shown in this table.

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*Distribution and value of fresh and dried apples exported from the United States in 1910, 1911, 1912, 1913, and 1914*—Continued.

| Countries. | Apples, dried. | | Apples, fresh. | |
|---|---|---|---|---|
| | *Pounds.* | *Dollars.* | *Barrels.* | *Dollars.* |
| West Indies: 1912. | | | | |
| British— | | | | |
| Barbados | | | 392 | 1,334 |
| Jamaica | | | 948 | 3,829 |
| Trinidad and Tobago | | | 781 | 2,802 |
| Other British | 56 | 5 | 559 | 2,114 |
| Cuba | 4,307 | 453 | 18,962 | 78,922 |
| Danish | 35 | 4 | 136 | 541 |
| Dutch | 306 | 38 | 63 | 279 |
| French | | | 108 | 408 |
| Haiti | 1,342 | 79 | 535 | 2,138 |
| Santo Domingo | | | 800 | 2,789 |
| South America: | | | | |
| Argentina | 84,340 | 9,315 | 8,464 | 36,882 |
| Bolivia | 1,100 | 128 | | |
| Brazil | 9,031 | 954 | 20,956 | 80,711 |
| Chile | 16,283 | 1,954 | 5 | 20 |
| Colombia | 1,637 | 219 | 731 | 2,888 |
| Ecuador | 365 | 46 | 8 | 39 |
| Guiana— | | | | |
| British | | | 587 | 2,093 |
| Dutch | | | 297 | 1,160 |
| French | | | 7 | 26 |
| Paraguay | 150 | 17 | | |
| Peru | 2,850 | 304 | 8 | 35 |
| Uruguay | 11,599 | 1,252 | 583 | 2,795 |
| Venezuela | 296 | 27 | 1,346 | 5,894 |
| The Orient (Asia) | 204,861 | 20,878 | 4,142 | 20,490 |
| Australia | 21,500 | 1,687 | 427 | 1,905 |
| South Africa | 56,817 | 5,505 | 5 | 39 |
| Egypt | 500 | 55 | 6 | 30 |
| Total[1] | 53,380,041 | 4,516,843 | 1,441,265 | 5,336,280 |
| 1913. | | | | |
| Europe: | | | | |
| Austria-Hungary | 35,733 | 3,453 | 5 | 30 |
| Belgium | 2,397,913 | 162,930 | 1,288 | 8,284 |
| Denmark | 1,516,658 | 100,514 | 17,439 | 53,021 |
| Finland [2] | 209,121 | 14,161 | 109 | 300 |
| France | 1,275,815 | 118,607 | 2,308 | 11,071 |
| Germany | 17,970,592 | 1,207,705 | 272,382 | 1,208,333 |
| Italy | | | 1,594 | 6,399 |
| Netherlands | 12,846,054 | 860,673 | 1,584 | 11,272 |
| Norway | 550,546 | 42,870 | 14,628 | 49,856 |
| Portugal | 7,650 | 466 | | |
| Russia in Europe | 64,000 | 4,534 | 312 | 1,325 |
| Spain | 8,900 | 570 | 8 | 29 |
| Sweden | 1,641,365 | 124,455 | 3,926 | 13,784 |
| Switzerland | | | 15 | 54 |
| United Kingdom: | | | | |
| England | 1,330,379 | 97,607 | 1,062,572 | 4,198,519 |
| Scotland | 69,050 | 5,857 | 235,824 | 852,548 |
| Ireland | | | 30 | 160 |
| Canada | 360,318 | 21,389 | 376,951 | 913,506 |
| Panama | 26,280 | 2,104 | 12,374 | 51,919 |
| Mexico | 126,098 | 10,728 | 31,271 | 107,443 |
| West Indies: | | | | |
| British— | | | | |
| Barbados | 25 | 2 | 734 | 2,034 |
| Jamaica | | | 1,476 | 5,217 |
| Trinidad and Tobago | | | 1,089 | 3,230 |
| Other British | | | 568 | 2,131 |
| Cuba | 8,468 | 679 | 19,745 | 79,183 |
| Danish | 25 | 3 | 227 | 779 |
| Dutch | 250 | 26 | 173 | 598 |
| French | | | 158 | 544 |
| Haiti | 1,600 | 167 | 626 | 2,008 |
| Santo Domingo | 371 | 31 | 749 | 2,380 |
| South America: | | | | |
| Argentina | 69,026 | 6,887 | 7,239 | 39,336 |
| Bolivia | 3,900 | 378 | | |
| Brazil | 8,786 | 855 | 14,172 | 62,109 |
| Chile | 10,115 | 854 | 10 | 49 |
| Colombia | 1,295 | 109 | 1,056 | 3,250 |
| Ecuador | 850 | 80 | 1 | 5 |
| Guiana— | | | | |
| British | | | 578 | 2,257 |
| Dutch | | | 207 | 740 |
| French | | | 9 | 33 |

[1] All countries are not shown in this table. [2] Included in "Russia in Europe" prior to 1911.

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*Distribution and value of fresh and dried apples exported from the United States in 1910, 1911, 1912, 1913, and 1914*—Continued.

| Countries. | Apples, dried. | | Apples, fresh. | |
|---|---|---|---|---|
| South America—Contd. | | | | |
| 1913. | *Pounds.* | *Dollars.* | *Barrels.* | *Dollars.* |
| Peru | 6,680 | 494 | 6 | 23 |
| Uruguay | 44,476 | 3,749 | 280 | 902 |
| Venezuela | 141 | 11 | 2,507 | 9,036 |
| The Orient (Asia) | 198,423 | 15,687 | 7,006 | 28,857 |
| Australia | 239,875 | 14,832 | 14,346 | 71,813 |
| South Africa | 138,824 | 14,705 | | |
| Egypt | 600 | 48 | 6 | 30 |
| Total [2] | 1,170,202 | 2,868,220 | 2,127,579 | 7,804,896 |
| 1914. | | | | |
| Europe: | | | | |
| Austria-Hungary | 22,928 | 2,238 | 17 | 135 |
| Azores and Madeira Islands | 700 | 61 | | |
| Belgium | 1,499,747 | 120,395 | 3,950 | 16,528 |
| Denmark | 1,209,171 | 95,379 | 6,455 | 28,101 |
| Finland [1] | 123,100 | 8,190 | 420 | 1,800 |
| France | 897,982 | 83,147 | 3,374 | 20,375 |
| Germany | 17,645,697 | 1,377,730 | 168,792 | 916,883 |
| Italy | | | 6,589 | 23,357 |
| Netherlands | 9,147,104 | 702,279 | 1,952 | 14,770 |
| Norway | 202,306 | 15,147 | 6,857 | 28,775 |
| Portugal | 300 | 40 | 3 | 15 |
| Russia in Europe | 50,560 | 3,274 | | |
| Spain | 27,050 | 1,806 | 16 | 67 |
| Sweden | 707,510 | 49,916 | 1,236 | 4,703 |
| Switzerland | | | 62 | 335 |
| United Kingdom: | | | | |
| England | 1,058,563 | 86,618 | 617,218 | 2,363,567 |
| Scotland | 21,750 | 1,868 | 209,797 | 749,323 |
| Ireland | | | 13 | 66 |
| Canada | 211,452 | 15,193 | 299,347 | 1,040,413 |
| Panama | 16,380 | 1,679 | 8,979 | 44,735 |
| Mexico | 63,047 | 5,690 | 11,080 | 50,580 |
| West Indies: | | | | |
| British— | | | | |
| Barbados | | | 130 | 484 |
| Jamaica | 48 | 6 | 1,099 | 4,485 |
| Trinidad and Tobago | | | 710 | 2,707 |
| Other British | 1,234 | 103 | 315 | 1,295 |
| Cuba | 6,298 | 616 | 13,764 | 74,180 |
| Danish | 136 | 11 | 159 | 711 |
| Dutch | 2,036 | 207 | 159 | 653 |
| French | 58 | 6 | 91 | 413 |
| Haiti | 455 | 40 | 364 | 1,343 |
| Santo Domingo | 100 | 8 | 791 | 3,392 |
| South America: | | | | |
| Argentina | 41,675 | 4,108 | 36,266 | 156,839 |
| Bolivia | 414 | 59 | | |
| Brazil | 4,410 | 492 | 25,314 | 124,520 |
| Chile | 14,678 | 1,579 | 214 | 1,357 |
| Colombia | 2,045 | 209 | 775 | 3,181 |
| Ecuador | 510 | 52 | | |
| Guiana— | | | | |
| British | 420 | 36 | 401 | 1,715 |
| Dutch | | | 138 | 599 |
| Peru | 1,550 | 144 | 104 | 619 |
| Uruguay | 5,850 | 524 | 2,925 | 15,358 |
| Venezuela | | | 2,017 | 7,916 |
| The Orient (Asia) | 184,020 | 17,842 | 7,063 | 34,681 |
| Australia | 189,250 | 13,284 | 35,536 | 200,847 |
| South Africa | 30,199 | 3,002 | 2,313 | 5,393 |
| Egypt | 300 | 29 | 6 | 30 |
| Total [2] | 33,391,032 | 2,613,007 | 1,476,811 | 5,947,246 |

[1] Included in "Russia in Europe" prior to 1911. [2] All countries are not shown in this table.

*Explanations.*—It should be remembered that at the beginning of the shipping season of 1914 foreign commerce was greatly disturbed and upset by the European war, and while our trade with foreign countries in apples was very satisfactory considering the conditions, still the United States produced one of the largest crops of apples in its history, and a larger export outlet was necessary in order to market the crop profitably. The statement of export shipments in

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1914 undoubtedly would show larger quantities but for the conditions created by the war.

The countries adjacent to the United Kingdom apparently do not take large quantities of American apples directly, but it is to be remembered that England, Scotland, and Germany have been the chief sources of supply for their neighbors. For instance, it is seen that Ireland has received only a negligible quantity direct from the United States. However, Ireland consumes large quantities of apples, which are purchased at the great fruit auctions of London, Liverpool, and Glasgow. This is true, also, of Scandinavia, Denmark, and Holland. So while apparently the statistics do not show a large trade in apples with many of the northern European countries, still goodly quantities go to them indirectly. In recent years Germany has taken increasingly large quantities of American apples direct, but chiefly the Empire's demands have been supplied through English channels. The closing of Germany to overseas commerce has proved to be a hardship to the dried-apple industry because Germany is the largest importer of this commodity, but shipments from the United States to Denmark, Holland, and Scandinavia have increased for the reason that many dealers in the north of Europe who had looked to Hamburg for dried-fruit supplies, now look to the United States.

Until five years ago the statistical records of the United States showed practically no trade in apples with the countries of South America. Substantial quantities, however, went to these countries through the medium of English dealers, large shipments of apples having been made formerly from New York City via Southampton and other English ports. It is gratifying to note that recently the status of our relations in apple trade with South America is changing, the tendency being toward more direct dealing.

*Exports regulated by the crops.*—The development of trade in apples between the United States and other countries has been rather slow, and apparently it has grown without systematic direction. Reference to the table of shipments will show that the quantities exported vary widely from year to year. This is caused by a variation in crop conditions, exports in the past having been regulated more by the supply in the United States, for when reasonably fair prices can be secured at home the tendency is to sell in the domestic markets rather than undertake the hazard of shipping to foreign countries, however good may be the opportunities.

The supply of merchantable fruit is regulated by the opportunity for profitable marketing. With the opening of markets the supply invariably will increase. Approximately only 50 per cent of the apples produced in the United States enter into commercial channels. The percentage of the crop marketed increases or decreases with the size of the crop. In 1914 exceedingly large quantities of merchantable fruit decayed in the orchards or were sold at very low prices for cider and vinegar making. Authorities assert that less than 16 per cent of apple trees planted in the United States come into full bearing. The neglect of orchards is caused largely by the discouragement resulting from poor marketing conditions, and it is reasonable to believe that the expansion of our foreign outlet would be attended by an improvement in horticultural methods and more prosperous conditions for all concerned.

### HOW THE PRESENT EXPORT TRADE IN APPLES WAS CREATED.

The development of foreign markets for apples must grow out of our past experience in this trade. Therefore, before undertaking to suggest ways in which foreign apple markets may be expanded, it may be wise to consider the methods through which the present trade has been established.

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*First efforts at exporting apples.*—America's foreign trade in apples began with small shipments made by growers or others in the States as gifts to friends in England. Among these early shipments, according to tradition, a Virginia grower of Albemarle pippins sent a few barrels of this variety to Queen Victoria. It is said that yearly shipments were made thereafter to the Court of England during the rest of the Queen's life, and that her preference for apples from the States became known throughout the Kingdom, to the end that the export trade in apples between the United States and England received a stimulus which has resulted in making the British Isles our chief foreign fruit market. Following the successful efforts at sending gift apples to England, enterprising tradesmen in the two countries saw an opportunity for transacting a lucrative business in the exportation and importation of this fruit. Trade connections were formed, and facilities for handling shipments and conducting sales slowly improved.

With the growth of the business, many of the tradesmen developed into large export firms, some of which still are engaged in handling this trade. Chiefly to the activities of these houses is due the development of the foreign trade of the United States in apples. In the natural course of enlarging their business they have sent their agents to form market connections abroad, and many of the importers have sent their agents to study the conditions and form connections in the United States. Whether or not the development has been adequate to meet the increasing needs of the American growers, it is desirable to pay a fitting tribute to the men who have opened the doors of foreign markets to American apple growers, for those markets have shown a strong influence here, and the trade which has been created serves as a valuable basis on which to operate more systematically in its organized expansion in future years.

*The establishment of fruit auctions.*—As the quantities of apples imported into the United Kingdom increased it became necessary to provide special facilities in London, Liverpool, and Glasgow for the sale and distribution of this commodity. Fruit auctions were organized by the brokers, and as the result of many years' experience these sales mediums have come to be the controlling factor in the marketing of American apples in Europe. This method of conducting fruit sales has extended to some of the other countries of Europe, as, for instance, at Hamburg, in times of peace, very large quantities are handled in this way.

Buyers come from all parts of the United Kingdom and northern Europe to the auctions of Glasgow, Liverpool, London, and Hamburg, 200 or 300 being in constant attendance upon the auction sales, thus creating a very effective and elastic channel through which American apples may reach the wholesale and retail trade of Europe.

*The organization of foreign auction brokers and buyers.*—The methods of conducting the auctions are very intricate and exceedingly interesting. The brokers at each market are organized into associations which largely rule the auctions. The buyers also are organized, and between the two classes the auction system has developed as a medium of exchange, with rules and regulations governing the selection and display of samples, the manner of sale, terms, etc.

The general rule in the British markets is that when consignments are landed the buyers learn from the steamship manifests by whom the shipments were made and the varieties and grades represented. The buyers' inspectors are on the docks and report to their principals the condition of the arrivals, while the brokers either inspect in person or through an employee. It is the rule to show, as samples, barrels selected from the dock which have not been inspected previously. Usually, when selling the fruit in lots of 10 barrels, two sample

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packages are shown in the saleroom. In Hamburg the two associations of buyers and brokers have an independent man to select packages in bulk to be used as samples, and no one is allowed to open the sample packages until the morning of sale; but there is no rule, as in England, regulating the separation of tight barrels from those which may be slack, although the latter may greatly influence the selling price of the whole lot from which the samples were selected.

It is the custom in all of the foreign auction markets to sell the arrivals as quickly as possible, without regard to the future supply and other conditions which influence the market. It matters not in one market what better advantages may be offered in another. The transshipment of apples by brokers to secure greater profit for their principals has been unheard of until recently. It often has occurred that Hamburg, for instance, would be found paying from $0.75 to $1 per barrel more than the English markets, and such a condition has been known to prevail for a period of weeks without causing an effort on the part of the brokers in England to secure this advantage for their American shippers.

Experience in exporting apples to Europe and the study of auction methods reveal the fact that most of the conditions imposed are in favor of the buyers. There is a tendency to show preference to the buyer's interest rather than to do the very best for the owner of the fruit, who may be several thousand miles away.

*Methods of preparing fruit for foreign shipment.*—The proper selection of apples for export shipment and the style of packing the fruit seriously affect the development of markets. In the past the great bulk of the apples exported have been prepared for shipment without much regard for the special demands of the foreign trade. This is true more particularly of consignments made by the growers and shippers of barreled apples, which constitute so large a percentage of the total production. While packing methods have greatly improved in recent years, the change has been of a general nature and not confined particularly to export stock, which would indicate that in the foreign marketing of apples no special effort has been made to develop trade by delivering goods that will give entire satisfaction and create a new demand.

The inspection of American apples in the European markets has shown for the most part that the fruit is poorly graded and packed. As a result the proceeds sometimes are so unsatisfactory to the American shippers that they believe themselves to be the victims of sharp practice, and are discouraged from making further attempts to establish their brands across the seas. The classification and the condition of apples sent to Europe has not been such as to encourage a rapid increase in exports. The growers and packers have been slow to adopt progressive and businesslike methods in preparing the product for export shipment and in safeguarding the physical handling so as to assure the approval of foreign buyers. Accordingly, the business has been conducted almost entirely upon the consignment basis, because it has lacked that element of stability which is necessary for satisfactory transactions upon a c. i. f. (cost, insurance, freight) basis.

*Passively supplying an active demand.*—It may be said that for the most part the trade of the United States in apples with foreign countries has grown by indirection. Most of the dealers, with only a temporary interest in the commodity and lacking the stimulus of permanent interest in orchard investments, have passively supplied an active demand without much expenditure of time and money in the expansion of old markets and the development of new ones proportionate to the growth of the orchard industry in America and the opportunities existing abroad.

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The result has been that our export shipments represent simply the overflow from the home markets into the channels of foreign trade. Foreign marketing has been looked upon as incidental to the disposition of the apple crop of the United States, and not as a coordinate part of a comprehensive marketing scheme.

DIFFICULTIES ENCOUNTERED IN THE DEVELOPMENT OF FOREIGN MARKETS FOR APPLES.

The problems to be solved in marketing apples abroad are very different from those which are encountered at home. There are peculiar difficulties incidental to foreign trade which are to be overcome before expansion can be secured in proportion to the need of the orchard industry. The difficulties are those of acquiring a knowledge of trade demands, making reliable trade connections, supervising the sales, effecting satisfactory credit arrangements, securing suitable and abundant transportation facilities, overcoming the hazards of shipping a perishable product great distances, settling claims upon steamship and foreign railway companies for damaged products, eliminating ruinous competition, and overcoming the discouragement which these difficulties have caused on the part of growers and shippers.

*Acquiring a knowledge of trade demands.*—To develop a market successfully it is necessary to know the kind of products, the variety, the grading and the packing required, and the terms upon which the business may be handled. The ways through which the individual American fruit growers and shippers may secure this fundamental information have been so devious that they are rarely assured of the manner in which to proceed or the results which they may expect.

*Making reliable trade connections.*—When a knowledge of the demands of foreign trade are learned a serious difficulty arises in making reliable trade connections. Without doubt this is one of the chief difficulties attendant upon the development of markets for apples.

Business relations are more satisfactory when there is a degree of personal contact, but owing to the great distances involved it is practically impossible in the majority of cases for the American shipper to know with whom he is dealing. Unless the trade connection is reliable, it is impossible for the market to be handled properly according to its demands; and in many cases, through the excuses made by an unreliable dealer for poor returns or for the rejection of shipments, the exporter has been misinformed to such an extent that he would cease making consignments to the market concerned, when not the conditions but the dealer was to blame for the unsatisfactory results.

*Effecting credit arrangements.*—The expense of growing and harvesting a crop of apples frequently taxes the utmost resources, even of the most prosperous producers, unless the crop is sold for cash at shipping point as the fruit is harvested. Furthermore, the American buyer frequently operates with little capital beyond the actual needs incidental to buying and selling on the open market. In shipping to Europe both the grower and the dealer meet with the difficulty of financing their operations until the proceeds of sale may be received.

This difficulty has been met in some cases by foreign brokers, who advance small sums as shipments are made from the orchard districts in the States. The effect of this arrangement is to bind the shipper to the broker in such a way that the latter may proceed according to his own desires in the disposition of the fruit. There are frequent disastrous foreign market changes while these mortgaged shipments are in transit from the orchards to seaboard, yet because of the advance payment on account, the passage of these cars can not be prevented by the owner of the fruit. The interest of the broker lies almost wholly in the small commission received for making sales, and it is only to be expected

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that exactions may be made for the favor of advancing money to the shipper some weeks prior to sale.

The adjustment of credits so that foreign trade in apples may be handled with the same facility as sales in the home markets is a problem which has restricted the development of over-seas trade between the United States and other countries, and its solution is essential for making foreign markets properly accessible to the growers.

*Securing suitable and abundant transportation facilities.*—Briefly it may be said that the proper transportation of a product that is perishable requires facilities that are different from the demands incidental to the exportation of nonperishable products. The transportation of perishable commodities to foreign countries has been one of the latest developments in shipping circles. Among the hazards of exporting apples is that of securing adequate and sufficient steamer space. This difficulty is well illustrated by the experience of those who have sought to increase our direct trade in apples with South America. It was considered desirable to effect economies by eliminating the necessity of having to deal with the Latin-American importers through the medium of English ports, but it has been found that the steamship facilities for the direct transportation of apples to South America have been inadequate for the demands.

Just at present there is much interest in the development of North America's trade in various products with the countries south of the Equator, but in the transportation of these products, particularly fruits which require special facilities, a serious difficulty is encountered in the lack of suitable and sufficient steamer space. The result has been a restriction of trade in a time when the opportunity for developing direct relations has been the best ever known by the exporters of this country.

*Hazards of shipping perishable products great distances.*—There are certain hazards incidental to the export shipment of apples which cause a restriction of trade. The fruit is handled physically so many times and in so many ways that frequently a damage results which causes serious loss. First is the transportation by railways, then the lightering to steamers, the loading of the cargoes, the toss of the ship on the high seas, and the discharge upon arrival in the foreign ports. For the most part, apples are transported on the fast steamers which sail on schedule, thus requiring great haste in loading and discharging cargoes, and resulting in much damage to the merchantable condition of the commodity.

Owing to the time required for delivering the fruit to foreign markets, deterioration often sets in and causes loss to the shipper or to the buyer. Furthermore, while shipments are on the ocean there may be disastrous market changes which may be impossible to overcome, due to the difficulty of diverting or storing in foreign countries.

*Settling claims for damaged products.*—The conditions imposed by the steamship companies apparently are all in favor of the lines, and not for the protection of the shipper. The clauses contained in the steamship bills of lading protect the companies against every contingency which may arise, whether due to the carelessness of employees or to other causes. The collection of claims by American shippers is almost impossible because of the intricate processes involved and the strong influences which must be brought to bear in effecting settlements. Most of the lines are of foreign register and difficult to reach through the courts of the United States. If it were possible to protect the shipper against the enormous loss due to the bad methods of steamship lines

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in handling apples, it is believed that a large difficulty attendant upon the development of foreign markets would be removed.

*Overcoming the discouragement of shippers.*—All of the difficulties which are encountered in the foreign marketing of apples tend to work a serious discouragement on the part of growers and shippers in the United States. As far as the grower is concerned so much is involved in the season's transactions that he can not well afford to suffer temporary losses in expanding markets for future crops. So, for the most part, they are disposed as individuals to take what the home markets may offer, rather than encounter the possibility of suffering a loss on foreign shipments. The removal of this discouragement is essential to the expansion of over-seas trade in apples because the grower's interest is the chief interest involved.

### SUGGESTIONS FOR THE DEVELOPMENT OF FOREIGN MARKETS FOR APPLES.

The elimination of the difficulties just named and defined is necessary for the development of foreign trade in apples. Accordingly, the suggestions to be given must comprehend the removal of such difficulties. It is hoped that benefit may be derived by both growers and shippers, for the purpose is to render assistance to all who perform an economic service in the foreign marketing and distribution of apples. Naturally owing to the fact that the orchard interest of the United States is the chief one involved, first consideration must be given to the producers in the recommendation of a marketing system.

*Grade and pack to meet the several market requirements.*—It has been complained that United States exporters in all lines have failed to cultivate foreign markets through the delivery of goods packed to meet the demands of over-seas trade. The complaint is especially applicable to apples. In the case of an old market the conditions are more or less settled, and through investigation the shipper may know what kind of grading and packing is required. In undertaking a new market experiments must be made, but in a short time it becomes evident just what is necessary to give satisfaction to the importers and consumers. The box-apple growers have developed the most satisfactory standards, and their pack, as a rule, is such as to please all markets. This is not true of the barreled-apple growers, and to them this recommendation is earnestly addressed.

It is required that export apples be in firm, clean condition at the time of packing. The fruit can not be exported safely if it is allowed to remain on the trees as long as fruit which is marketed locally. In the case of those States which go to market first it is not good business to leave the apples on the trees until they have reached full maturity and color. Usually the best values are realized on early shipments, and the foreign trade is not so exact as to color until supplies are plentiful. Furthermore, color represents the stage of maturity, and when the apples are held for full color they frequently are too ripe for safe transportation.

In picking and packing special care should be exercised to avoid bruising the fruit, because the time required for shipment and the rough handling and changes of temperature to which the product is subjected is a severe test of its physical endurance. The apples should be hand-selected and carefully graded according to recognized standards.

Strong, well-made packages must be used so that burst hoops and slack barrels may be avoided. Corrugated caps should be placed in both ends of the barrels. Protection should be provided against rain and extreme heat or cold at time of harvesting, packing, and shipping. The grower who subjects his apples to rough treatment and packs the fruit under a hot sun into barrels that are heated

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and then hauls without springs over rough roads to the cars in all kinds of weather is a menace to the general good in marketing our export apples. He does not deserve success, and, if he persists in these methods, the sooner he suffers disaster the better it will be for the industry.

*Appropriate laws desirable.*—Laws are frequently required to protect us against ourselves. For more than a decade various responsible agencies have worked to secure an improvement in the methods of preparing apples for market. Packing schools have been conducted throughout the commercial orchard districts, and this work has resulted in producing better grades and a neater style of pack. However, there is a very large number of irresponsible people among those engaged in the production and marketing of apples, and against this class, which may be expected to persist, the industry needs protection. A Federal statute fixes the standard barrel, and another law was passed providing for standard grades, but nothing is to prevent the packer from doing as before, because he is not compelled to abide by the standards of the statute.

Realizing the very great importance of shipping uniformly well-graded and packed apples in the development of over-seas trade, and realizing that the industry will not adjust itself so as to meet this need, it is suggested that a Federal law requiring specific grades and providing for careful inspection at seaboard and authorizing condemnation proceedings in the case of shipments which do not meet the legal standards would be of untold benefit to the apple industry of the United States in developing trade with foreign countries. The Fruit Marks Act was designed to do for Canada what is here suggested for the States, and the enforcement of the law is said to have had a very salutary effect upon the foreign trade of the Dominion.

*Cater to the desires of foreign importers.*—To develop a trade it is required that the business be transacted in a manner acceptable to the purchasers. The people of the United States have been disposed in no little measure to carry on trade with foreign countries in a manner most acceptable to us. However desirable changes in foreign methods may or may not be, still, in order to secure over-seas patronage, a conformity with the customs of our patrons is essential. With many foreign peoples the personal element is sometimes more vital than the business involved, and in many cases a prejudice or a spirit of antagonism rather than of cooperation unwittingly may be aroused to the lasting obstruction of satisfactory business relations. For instance, importers who have been accustomed to receive only such apples as have been ordered previously, thus anticipating their needs and preventing gluts, may not be pleased at the efforts of a foreign exporter who endeavors to force the expansion of their market by consigning large quantities on shipper's order. Immediately antagonism is aroused on the part of the importers and untold difficulties appear in developing trade with that market.

If the apple growers and distributors of the United States expect to expand the foreign trade in apples in proportion to the needs of the industry, they assuredly must endeavor to deal fairly and tactfully with those whose patronage is sought.

*Secure adequate insurance.*—The hazards incidental to the physical handling of export apples require that adequate protection be provided in order to prevent loss to the shipper or buyer and a consequent discouragement for both. It is doubtful if the insurance companies provide for a contract that is designed to cover those physical hazards which are most commonly encountered. It is reasonable to believe that with the enforcement of a law designed to regulate the export shipments of apples in respect to the grading and packing of the



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fruit a basis would be created for the application of scientific insurance against deterioration or other damage in transit. If protection can be secured in this way, the speculative feature will be reduced and greater satisfaction enjoyed by all concerned.

*Open consignment sometimes necessary to establish a new market.*—When it is undertaken to develop new foreign markets for apples, excepting in the case of widely known organizations or export firms, the foreign importer may lack confidence in the representations of the shippers and fail to place orders. There must be a disposition on the part of the exporters to show good faith by supporting their representations with actual consignments. Of course, care is to be exercised in making trade connections abroad, but when the shipper is assured that the best possible connection has been made, then he should proceed to establish his brands and lay the foundations of a permanent trade. Many experiments are to be performed in establishing a new market, and these experiments naturally must be largely on the part of those seeking markets. Until it is known what varieties are wanted and how they should be graded and packed, and until confidence is established among the importers, the shipper is compelled to assume much risk and sometimes to undergo temporary losses. However, the advantage gained proves a permanent benefit.

*Supply foreign markets uniformly.*—When a market has been opened, it does not remain open of its own accord. There can be no negligence on the part of the exporter, because the market must be cultivated continuously. To fail in holding a market is just as serious as failure to create it.

When a brand of apples has been established, constant uniform supplies are necessary from year to year to keep it established, and through a lapse of attention to the needs of the market in this respect practically all the advantage gained originally at so much expense may be lost to a more enterprising neighbor.

Frequently it occurs, in the case of shipping organizations, that the good judgment of the management is subordinated to the whim of the members in matters pertaining to foreign marketing. There comes to mind the recent experience of a large fruit growers' association, which for several years had been especially active in expanding its over-seas trade. The foreign sales were handled so effectively that not only was an outlet created for immense quantities of apples at a time when profitable marketing at home was difficult, but also the average prices received were substantially more than what was realized in the United States.

At the last of the season a few car lots of apples became involved in the requisition of steamers by a foreign Government which took possession of the cargoes and forced the sales. Claims were lodged by the organization's foreign office and much time was consumed in securing settlements. The delay made it impossible to close the pools and make final settlement with the growers. Although the remainder to be paid the individual members was negligible, they became very discontented and developed such a sentiment against foreign marketing that the directors deferred to the prejudice which grew out of an unimportant event and a temporary inconvenience, by practically closing the organization's foreign channels which had been created and maintained so profitably for both the agency and its members.

The fruit industry in some sections of the United States depends in no small measure upon the development of trade and the expansion of markets in foreign countries. This is to be accomplished only by aggressive action on the part of the distributors in following every advantage. In the case of organizations of growers, it is folly for the officers to pander weakly to the

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attitude of members who may not comprehend the conditions. Every effort should be made to enlighten them, but good business judgment and not prejudice should direct the development of markets.

*Direct marketing.*—For many years the United Kingdom has been the chief foreign market for North American apples. Nearly all of our exports have been to that country, but not entirely consumed there. English dealers have supplied Europe, South America, and other sections of the globe.

In serving as a channel for the distribution of our apples across the seas, the British dealers have rendered a signal service to the apple industry of the United States. Naturally they have exacted toll, and there has not come to the growers and shippers of the United States and the consumers of foreign countries the full advantage of the trade which has been carried on through the United Kingdom.

The growth of the orchard industry of the States requires the most rapid expansion of foreign markets that may be consistent with good business principles. It is required that economies be effected in every way possible.

With all due respect to British dealers, the apple exporters of the States should go direct to those countries which formerly have been supplied wholly or in part by the United Kingdom. Instead of paying the dealers of the United Kingdom a toll for selling our apples to foreign people, American growers and shippers should arrange, when practicable, to perform this service for themselves and enjoy the benefits which would accrue from direct trade relations with all the foreign markets.

*Utilization of the Panama Canal.*—There has been much speculation on the part of growers, dealers, distributors, transportation companies, and theorists as to the benefits which may be derived by the apple industry from the operation of the Panama Canal. Only one or two distributors have experimented with it as yet.

During the season of 1914–15 several shipments of apples destined for Europe were made from the Pacific northwest through the canal. Although the time required was much greater than for the overland routes, the physical handling of the fruit was entirely satisfactory excepting in the case of one lot which was supposed to have deteriorated as the result of difficulties with the refrigerating machinery. Even with the present limitations as to steamship facilities, rates are secured which represent a substantial saving to growers and shippers near seaboard.

In time, as the Panama Canal shipping increases, facilities may be expected to improve and rates reduced. The canal is the natural route from the east coast of North America to the west coast of South America and the countries of the Orient. It opens the markets of eastern South America to Pacific coast shippers both of Canada and the United States, and as facilities improve the water route to Europe from the far western districts will come to be more important than now realized, for undoubtedly shipments so made will go direct to the foreign markets as originally loaded into cold chambers on the Pacific coast.

The benefits to be derived by the apple industry from the operation of the Panama Canal will be enjoyed chiefly on the Pacific coast, because the center of the foreign consuming population lies east of the canal. Constant utilization of the water route by the apple shippers of the far Northwest will enable them to realize such benefits more readily. They can hope for improvements in facilities and rates only as they patronize the route.

*Commercial representation.*—In its investigations of the foreign marketing of manufactured products the United States Bureau of Foreign and Domestic

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### THE STRUGGLE WITH WEEDS.

One very serious reason why the agricultural occupation of the Tropics must be on an intensive basis lies in the continuous and rapid growth of weeds that greatly increase the labor and expense of clearing and cultivating the land. The tropical farmer can not stop for winter. There is no ally in the form of frost to keep the weeds from growing, and the land is practically lost if neglected for a few months. Once taken by weeds the land must be allowed to grow up to bushes so that it can be cleared again by fire, or at much greater expense by hand labor, which can be used only when it is very cheap. The alternative is to use the land constantly and keep it covered, as far as possible, with useful plants instead of with useless weeds injurious to crops and costly to remove.

### PROMISING TROPICAL TREE CROPS.

The Tropics afford an enormous number of valuable tree crops, adapted to the widest possible range of natural conditions and uses. Forests of useful trees will be a feature of the intensive system, to replace the worthless weeds and bushes that now cover large areas of waste lands in many tropical countries, as a result of the desultory methods of tropical exploitation followed in the past. Three classes of tree crops of great potential importance may be mentioned as illustrations:

*Oil-producing palms.*—There is a rapidly increasing demand for vegetable oils as substitutes for meat and dairy products, and for many industrial purposes. Two important sources of vegetable oils are the coconut and the African oil palm, *Elaeis guineensis*. The coconut is widely known and its culture is rapidly extending, but the African oil palm is still confined to a single region. The fruits of the oil palm have a fleshy, oil-producing pulp as well as an oily kernel, so that two kinds of oil are produced. But the fresh pulp also serves directly as a food, has an excellent flavor, and is highly nutritious. Thus the oil palm is worthy of consideration as a food crop in any tropical region, quite apart from the commercial possibilities. Nevertheless, the practical utilization of such a tree outside its native country depends upon a well-supported policy of intensive development, for palms and other tree crops take time to grow and must be planted in large numbers if products of commercial importance are to be obtained.

*The avocado as a food crop.*—The avocado is widely known, but its possibilities as a food crop are seldom appreciated and nowhere fully realized. The varieties are numerous and differ widely in season of maturity as well as in other respects, so that production could be carried through several months and probably through the entire year in many tropical and subtropical regions. The fruits are savory, highly nutritious, and easily digestible. The trees are large, long-lived, and very productive. Obviously the avocado might become a very important element of the food supply of progressive communities organized to take full advantage of the natural resources of production.

*Cacao culture undeveloped.*—Cacao is recognized as an important tree crop, but its possibilities are still very far from being realized. Many problems of culture and protection against disease remain to be solved, but these are not the only directions from which progress may be expected. The consumption of cacao in temperate regions is still very far below its true possibilities, owing to the fact that the methods of preparation and use are still very imperfect. The result is that cacao is used mostly as a flavoring material, very little as a food. Indeed, it is customary to extract and discard from manufactured

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forms of cacao the oily materials that represent the most nutritious elements. The manufacturing processes yield a residue often indigestible and unattractive in taste, and altogether inferior to the beverages that the natives of Central America know how to prepare directly from the dried seeds. With the problems of production and utilization once adequately solved, the growing of cacao might become the chief branch of tropical agriculture. Linnaeus gave cacao the name Theobroma, or food of the gods. What is now needed is to make it fully available as food for men.

CONCLUSIONS.

Agriculture in the Tropics is undergoing rapid changes by reason of the application of modern improvements in machinery, electric transmission of water power, transportation, communication, and hygiene. In connection with this movement more intensive systems of tropical agriculture are needed—systems that are able to support larger populations for longer periods of time, and thus able to justify the installation of the modern facilities of production, comfort, and protection against disease. In developing these more intensive systems of tropical agriculture much more is to be expected from a greater utilization of tree crops than from attempting to carry agricultural methods of temperate regions into the Tropics.

The CHAIRMAN. Is there any discussion of Mr. Cook's paper?

Mr. MAYO. It seems to me that in the discussion of a subject of this kind we must forget, at least to a considerable extent, our strictly American view of Latin-American conditions. We must remember that much of Latin America is very primitive; that the land holdings there are usually not very large areas; that the wealth is in the hands of comparatively a few individuals; and that the natives as a rule have had very little opportunity for development other than that which they have wrought out by themselves.

I remember, when I first went into the Tropics, I went to see a native who was buying a few cows from an American. After he had picked out his cows I asked him through an interpreter what points he based his judgment on in making his selection. He said, "The horns and the hair and the tail"; and that was an entirely different method from our American point of judgment in the selection of cattle. I asked him why he based his opinion on the horns. His answer was that he sold most of his bulls for work cattle, and that he picked cows that had big, strong horns because they yoked them entirely by the horns.

I asked about the hair. He said if you got these American cattle with long coats of hair, that the ticks would eat them up. Then I asked him about the tail, and he said that when a cow had a long tail it walked faster than it did with a short, stubby tail. I was not so sure of that, on a scientific basis.

But the point is that they look at things from an entirely different point of view. They have, from experience, adapted themselves to

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Commerce has discovered a general weakness on the part of the exporters of such products in their lack of personal contact with foreign importers. In contrast to American methods attention has been called by the bureau to the activities of foreign exporters who send commercial representatives into the markets of the world to study trade demands and solicit patronage.

The weakness of the manufactured product exporters of the United States is also characteristic of the shippers of farm products. Until very recently the apple industry has not been represented in foreign countries excepting by foreign brokers, although the hazards and difficulties encountered in marketing a commodity which is so perishable as the apple are much greater than in the case of nonperishable products.

It is to be remembered that the largest portion of the apple exports are made by open consignment to brokers who sell the fruit at auction. Owing to the fact that the shipments are absolutely subject to the disposition of the brokers, under a sales system which is favorable to the buyers who are present rather than to the owners of the fruit who are several thousand miles away, it is desirable for best results that the shippers station their individual or joint representatives in the markets to receive the consignments and direct disposition of the fruit in a manner satisfactory to both the shippers and the buyers.

The chief interest of the foreign broker is to handle the largest amount of fruit possible, so that his commissions may be substantial. The chief interest of the shipper's commercial agent is solely the interest of his principal, and therein lies the difference in efficiency. The brokers may advise the continuance of shipments whatever the outlook may be, while the agent, looking to the welfare of his employer might advise curtailment or discontinuance.

The personal element enters very largely into the foreign marketing of apples, and the contingencies which arise can not be dealt with satisfactorily when the shipper is so far away. Aside from supervising the work of the brokers the exporter's commercial agent can render a most valuable service in developing new markets. Progress in establishing brands of apples abroad is very slow and sometimes failure ensues when the shipper uses the old methods.

The difference in results secured with and without commercial agents is exactly the difference between going after a thing and waiting for the thing to come to you. If the apple growers and shippers of a country desire to expand their foreign trade they must go after the business by studying the foreign conditions, by soliciting the foreign patronage and adjusting their methods to the requirements of the foreign trade through the activities of their own skilled agents. The work of the special representatives must be performed in close collaboration with the foreign brokers and dealers, without whose cooperation success is impossible.

*The operation of cooperative organizations.*—The suggestions so far given for the development of over-seas trade are meant to apply to all shippers of apples, whether the growers or the dealers. As far as the individual producers are concerned it is practically impossible for them to overcome the difficulties attendant upon foreign marketing. They are specialists in production and have neither the time nor the personal contact with market conditions which are required for securing satisfactory results.

The problems encountered in establishing profitable trade relations with foreign countries are not only impossible of solution by the isolated grower but, on the other hand, excepting in the case of a very limited number of operators, the middlemen themselves are unequal to the difficulties. They have not rendered a service in the foreign field proportionate to the needs of the industry.

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Notwithstanding the fact that it is practically impossible for the growers to solve individually the problems incident to marketing their apples across the seas, still as the producers and original owners they are the primary distributors. Therefore, it is reasonable to conclude that the future of the apple industry depends largely upon the extent to which they exercise an intelligent effective control over the distribution. Such control does not mean necessarily the elimination of those middlemen who are performing an economic service in apple marketing, but rather the selection and effective utilization of the best trade mediums.

It is not difficult to arrive at a conclusion as to how the apple growers may supervise most effectively the distribution of their products in the development of foreign markets. The experience gained from actual experiments performed during the past few years by certain communities suggests the best way. Through the organization and efficient operation of cooperative marketing agencies locally and generally, over definite producing areas, the apple growers of those areas may convert their individual weakness into united strength.

The amount of fruit marketed through an organization determines its capacity for solving the problems involved. In the case of foreign marketing, it is to be remembered that the difficulties are especially great and that to be successful an agency must have the extensive resources which are available only through the control of a proportionately large tonnage. The tonnage and not the number of members measures the strength of a cooperative marketing organization.

The plan and methods of such an agency should be designed to do for the member what he is unable to do for himself in developing foreign markets, namely:

To conduct comprehensive foreign investigations for the purpose of knowing the trade demands and making reliable trade connections.

To prepare the fruit for market so that the grading and packing may be in accordance with the best trade demands and so that credit rather than discredit may be reflected to the entire community of producers.

To establish community brands for the various grades so as to have a basis on which to advertise widely in foreign countries.

To supervise the physical handling of the shipments through to final destination and to secure adequate insurance so that the hazards may be reduced.

To control the consignments and supervise the foreign sales at auction through the employment of capable foreign agents in the respective countries.

To expand old markets and develop new ones by direct contact and through the solicitation of the special agents.

To so adjust credit arrangements that the members may not suffer the inconvenience caused by the delays of individual methods and so that they may avoid the bad practice of mortgaging their shipments to independent brokerage agencies.

To pool the proceeds of all sales according to the varieties and grades over definite periods so that profits and losses may be equalized and so that new ventures may be undertaken in developing virgin markets without involving disastrously the welfare of the individual.

Cooperative marketing is no longer an experiment. Even as supported by the half-hearted attitude of the farmers in the United States, great benefits have been derived from it. Several fruit growers' organizations have demonstrated fully what the combined growers of a district are able to accomplish in the foreign marketing of apples.

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It rested with a small association in Virginia to make the first attempt by any community of growers in the United States to control the sales of their apples in Europe. Unfortunately the Virginia union had meager resources, far short of those demanded by the difficulties encountered. The growers had not been accustomed to pack their fruit, for the crops formerly had been sold on the trees. Naturally the organization's shipments to Europe were not in uniformly good condition, nor always graded and packed to meet the best trade demands, so the results of the foreign sales were not altogether satisfactory to each individual grower, because the fruit was sold and settlements were made according to the merits of the different packs. In consequence, the membership ranks became infected by suspicion and discontent, with the result of serious disruption, although in the case of the good packers, prices were realized through the organization far in excess of values received outside.

The struggle of the organization in Virginia to overcome the unnatural limitations which are imposed by the members have made it impossible to fully carry out its original plans, but the vital fact is that the little band of growers who have been loyal to the association have been instrumental in demonstrating to the apple growers of the United States how they can best conduct their foreign sales. The system and the organization's European agent who perfected the system have been adopted by the largest group of cooperative apple growers' organizations in the world. Supported by standard grading and packing the joint foreign representative of these American cooperatives has demonstrated the benefits which may be derived by the apple growers through united effort and commercial representation in the foreign marketing of apples.

## CONCLUSION.

There are many virgin markets for the apples of America. The Orient with its millions of people is practically untouched. Limited quantities are sent to China and efforts have been made once in a while by individuals in the Northwest to establish more direct contact there, but individual resources were rarely equal to the undertaking. The few experimental shipments met an instant demand at excellent prices, but the expense and time required were so great as to discourage further attempts.

India for some years has received small shipments of American apples through the English dealers, and a few experimental shipments have been made successfully direct from New York. It is thought possible to make of India a good customer.

Australia and Tasmania supply the markets of many foreign countries in the interim between the North American seasons. So in many places the demand for apples is already cultivated, thereby making it less difficult to introduce the American fruit.

The development of these foreign markets and the expansion of outlets already established await the united efforts of the American apple growers and shippers. The possibilities of cooperative marketing on the part of the growers have been demonstrated. A degree of cooperation may be possible on the part of apple-export shippers. Though they may not combine extensively for the control of the domestic markets, it remains to be seen if they may not combine to effect the development of foreign markets through the joint employment of general foreign consignees and commercial agents, so long as they may not attempt to monopolize the business or to fix prices illegally.

The large increase in apple production, which is considered to be inevitable during the next decade, may mean a decrease in the percentage of the crop actually marketed and a serious loss to the producers, unless both the domestic

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and the foreign outlets are expanded to the utmost capacity. The old methods are not considered to be adequate, and therefore the adoption of more progressive measures is urged so that the foreign markets may be cultivated in a manner proportionate to the growing needs of the industry.

## THE PRINCIPLES AND PRACTICES OF COOPERATION APPLIED TO CITRUS PRODUCTION AND DISTRIBUTION.

By G. HAROLD POWELL,

*Manager California Fruit Growers' Exchange, Los Angeles, Cal.*

The cooperation of the citrus fruit growers in California in working out the problems of production and distribution has resulted in the development of 200,000 acres of orange and lemon groves from a semiarid desert. In a normal crop year the growers ship 20,000,000 boxes of fruit, or 50,000 carloads. The crop brings a return of $40,000,000 to California and has a delivered value of $50,000,000.

Twenty years ago the growers produced 5,000 carloads and each grower tried to handle the problem of production and distribution alone. The markets on the average were 2,500 miles distant. The facilities for distribution were undeveloped, the freight rates high, the crop perishable. The growers sold the fruit to local buyers, to distant buyers, or consigned it. But the buyers would only buy when there was a chance to make money; at other times the grower had to assume the risks of distribution, or would have to sell at a sacrifice. Later on the buyers divided the territory and did not compete with each other, or they fixed a maximum price to be paid for the fruit. Under these conditions the grower, of course, became helpless. He was too small a unit to cope with the larger interests with which he came in contact. The crop was increasing rapidly, the returns to the grower were diminishing, and he was forced to cooperate with his neighbors in handling their common problems jointly, if his property interests and theirs were to be safeguarded. Economic necessity which is the foundation stone on which successful cooperation among farmers must be founded, forced the growers to form associations, build packing houses, develop organizations, assemble the fruit of the members, standardize the grades and sell the fruit as a large business transaction. Finally the associations were obliged to federate in order to develop a uniform system of distribution that would place the fruit regularly in the markets of the United States and Canada. Without a system of uniform distribution under the control of the producer, and the regulation of the handling of the fruit, chaotic marketing conditions existed. The associations finally formed a central agency now known as the California Fruit Growers' Exchange, which includes 17 district exchanges, composed of 140 local associations of from 40 to 300 members each, and acts as a clearing house in furnishing facilities through which 8,000 growers, representing 70 per cent of the industry, distribute and sell their fruits on a cash basis at the cost of operation to the jobbers in the markets of the United States, Canada, the United Kingdom, and other countries. There are also a number of smaller cooperative associations among the citrus growers which operate somewhat as the exchange does.

The citrus fruit growers in California cooperate in the production of the fruit, in its distribution and sale, and in the development of a greater consumer demand through national advertising.

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In production they cooperate in the purchase of orchards supplies, such as fertilizers, cover-crop seed, and other materials. They cooperate in the manufacture of box shook, in the purchase of paper and packing-house materials, in the manufacture of by-products, in the protection of the fruit against frost injury, and in every way in building up better educational or investigational facilities by the State or Federal Government, which place the industry on a better basis and lead to a better rural life.

### A GROWERS' SUPPLY CO.

For the purchase or manufacture of supplies for the groves and packing houses the exchange growers have formed a corporation with a capital stock of $1,500,000, most of which is paid in, and is invested in timberlands and mills for the manufacture of boxes. Though organized as a stock corporation with the exchange associations as stockholders the Fruit Growers' Supply Co. conducts its business primarily for the benefit of the individual grower, who shares its benefits in proportion to the business he transacts. The boxes which it manufactures are furnished the growers at the cost of the material and of manufacture, which includes charges for depreciation and maintenance, plus 6 per cent on the capital invested. The supplies used in the orchards or packing houses are furnished the growers through their associations at wholesale cost or at prevailing retail prices with a refund of the difference at the end of the year. The cost of operation also includes an interest rate of 6 per cent on the capital invested.

During the year ending August 31, 1915, the value of materials handled by the supply company was $4,061,556, including $2,500,000 packing-house supplies, $840,000 in orchard supplies, and $770,000 of lumber and lumber products sold at the mill.

The cost of operating the supply company is approximately two-thirds of 1 per cent of the value of the materials handled. In 1914–15 it furnished the members 12,000,000 boxes, $49,675 worth of labels and box embellishments, $515,700 worth of fruit wrappers, $99,500 worth of nails, $874,000 worth of sodium cyanide, and $25,600 of sulphuric acid for fumigation, and $233,000 worth of fertilizer. The supply company returns $140,000 in refunds to its members at the end of the year in addition to 6 per cent on the capital invested. The supply company has saved its members $500,000 a year in the cost of box materials since its organization. It has saved not less than $150,000 a year in the purchase of fruit wraps, labels, nails, orchard supplies, and miscellaneous purchases, making a total saving of not less than $5,250,000 in eight years; and in addition it has been the most powerful factor in standardizing materials and in eliminating fraud and dishonesty in the materals handled. The funds for the supply company have been provided by levying an assessment of a definite amount per box against each shipper, the full amount to be paid in five years at a rate not to exceed 3 cents per box in any one year. Certificates of stock are issued to the associations representing the amount of an assessment paid.

### A GROWERS' BY-PRODUCT ASSOCIATION.

The lemon growers of the exchange have organized a corporation with a capital stock of $100,000 for the manufacture of by-products, such as citric acid and lemon oil from the lower grades of fruit. This organization, though incorporated as a stock corporation with the lemon shippers as stockholders, will pay 6 per cent annually on the money invested and after deducting operating expenses will return the proceeds to each member prorated on the

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amount of lemons contributed. There are $1,500,000 worth of these products imported annually from Italy and these will hereafter be manufactured in part or in whole by the California lemon growers. This organization is financed on the same principle as the supply company.

### MUTUAL INSURANCE ASSOCIATION.

The growers of the exchange have also organized an association through which the insurance on all packing houses and the supplies is carried on a mutual basis. The rules and regulations which govern the mutual indemnity compact are in force in determining the risks and rates to be charged each member. The losses are prorated on each association on the amount of the risk carried by each.

### FROST PROTECTION ASSOCIATION.

In some communities all of the growers have formed an association to assist in protecting the groves against injurious frosts. A frost district is formed, thermometers are installed throughout it, the district is thoroughly patroled at night, and when the conditions warrant it the patrolmen notify the individual growers who have already equipped their groves with frost-fighting devices that firing must begin or in some cases the association itself may handle the firing operations for the growers.

### THE CITRUS PROTECTIVE LEAGUE.

The California citrus industry has also formed a voluntary organization, without capital, known as the Citrus Protective League, to handle the public policy questions that affect the industry as a whole. It represents 90 per cent of the growers in all parts of the State in handling railroad rates and general transportation problems, customs tariffs, and other governmental relations, State and Federal legislation that affects the citrus industry, and all other questions of a general nature that affect the upbuilding of the industry. It avoids all questions that lie within the province of the established marketing agencies. It develops a constructive policy for the improvement of cultural practices and of fruit-handling methods, and then secures the cooperation of the State and Federal agencies best adapted to the upbuilding of these lines.

The work of the league has had a far-reaching influence on the industry. It has saved the growers nearly $1,000,000 a year in reductions in freight and refrigeration rates. It took a leading part in securing larger appropriations from the State for the building up of the college of agriculture, and it helped in securing the appropriation for the establishment of a citrus experiment station. The league is supported by funds raised by general assessment based on the number of cars of fruit shipped by each member during the preceding year.

### THE CALIFORNIA FRUIT GROWERS' EXCHANGE.

The most important of the cooperative movements in California is the California Fruit Growers' Exchange, from which all of the movements described have sprung, and which is the pattern on which every important cooperative movement in America is more or less shaped. The exchange is a growers organization, formed and managed by them for their own benefit. The operations are conducted at cost.

There are three units in the exchange system: First, the local associations of growers who build packing houses, assemble the fruit, grade and pack it

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under rules and regulations, and load it on the cars for shipment. The local association may be a stock corporation or a nonstock corporation. If a stock corporation, the stock is owned by the members, and it usually receives no dividends except the usual rate of interest for the use of the money.

The association has a board of directors who serve gratis, a manager, who is a paid officer, and other employees needed. The investment in a packing house may vary from $10,000 to $150,000, and the value of the product shipped from $50,000 to $1,000,000. The funds for building a packing house are furnished by the sale of stock to growers usually prorated on the acreage of each. In addition, the corporation may secure funds from a bank by giving a corporation note as security, and repays the bank through a period of years by withholding certain percentages from the sale of fruit. These organizations, though stock associations, are not organized for pecuniary profit and no dividends are paid on the stock. When the association is formed as a nonprofit corporation, the money needed to build and equip the packing house is secured on a corporation note and repaid by withholding a certain percentage of the proceeds of the sale of fruit, or by assessing each package sold a definite amount.

The association usually picks the fruit for the grower in order to standardize the physical handling and prevent the decay that follows improper handling. Each association packs the fruit under brands that are the exclusive property of the association, thus preserving the individuality of the local unit. The trade-mark brand of the central exchange also appears on the wrappers and boxes, thus giving the association the double value of its own brand in selling to the jobber, and the pulling power of a nationally advertised brand with the consumer.

The influence of the local brand is strongest with the jobber, less so with the retailer, and practically unknown to the consumer. The nationally advertised brand is most powerful with the consumer, and it is utilized by the jobber and retailer in promoting the sales of the association brand.

In practical operation the fruit of similar grades of the different members of the association is mingled and sold in common, a pool extending through a month, more or less.

When a carload is ready for shipment it is marketed by the district exchange, with the advice of the association, through the agents and facilities provided by the California Fruit Growers' Exchange, and the proceeds of the sales are divided among the members of the association pro rata on the number of pounds of each grade shipped in the pool.

The strength of the cooperative movement depends primarily on the efficient management of the local association. The basis of a successful marketing organization is the loyalty and steadfastness of the man on the land. His interest may be sustained or killed by the local association, because that is the organization with which he comes in direct contact. If the local association is weak the grower suffers, and he judges the entire movement by the standard of his local. Therefore it is essential in a large cooperative organization that practical steps be taken by the central organization to maintain the highest possible efficiency in the handling of the fruit and in the business management of the locals.

### THE DISTRICT EXCHANGE—ITS ORGANIZATION AND FUNCTIONS.

The district exchanges, of which there are 17, are composed of the local associations, and, like the associations, are nonprofit corporations, operating for them at actual cost, or are pecuniary stock corporations operating on cooperative principles. Each exchange acts as a medium between the associations

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and the California Fruit Growers' Exchange. It orders cars for the associations and sees that they are placed for loading, keeps records of the cars shipped by its associations, informs itself through the California Fruit Growers' Exchange of every phase of the distributing and marketing business, and places this information before the associations. It also receives from the agents the proceeds from the fruit and turns them over to the associations for pro rata payment to the growers, as above explained, after deducting the actual cost of operation, which usually amounts to 1 cent or less per box.

### THE CENTRAL EXCHANGE—ITS ORGANIZATION AND FUNCTIONS.

The California Fruit Growers' Exchange is the central body formed by the 17 district exchanges, with a directorate consisting of one representative from each of these exchanges, who serves without pay, and a general manager, who is a salaried officer. Like the associations and the district exchanges, it also is a nonprofit corporation, conducting its business at the actual cost of operation and declaring no dividends. It has no assets except a paid-in capital of $1,700, office fixtures, and supplies, although it distributes $20,000,000 to $25,000,000 worth of fruit.

The exchange has a legal department, which looks after any litigation that may arise; a traffic department, which looks after the routing of the cars and handles all shipping claims; an advertising department, through which an extensive advertising campaign is conducted to increase the demand for fruit and to establish a closer working basis with the jobber and retailer.

The central exchange furnishes facilities for the distribution and marketing of the fruit by the district exchanges, and to do this it has placed bonded agents in the principal markets of the United States and Canada. These men are exclusive salaried agents, except in territories where only a small quantity of fruit is sold, in which places the services of brokers are sometimes used. These agents work constantly to increase the trade, and in the sale of a car act directly under the order of the shipper. When a buyer wants a carload of fruit he takes the matter up with the agent in his city or district; the agent wires the details to the central exchange; this exchange takes it up with the district exchange handling the brand of fruit desired; the district exchange takes it up with the association which owns such brand, ascertains the price it is willing to accept, and communicates the reply to the central exchange; and the latter wires it to the agent, who then negotiates with the buyer. Any further communication necessary until the sale is effected or rejected is carried on in the same way between the agent and the shipper. When a sale is made the agent collects the money in the form of a check made payable to the California Fruit Growers' Exchange. This check is deposited in a national bank, and at the same time a check is made payable to the shipper of the fruit, covering the full amount. This, with a duplicate deposit slip showing that the money was deposited, passes through the office of the California Fruit Growers' Exchange to the shipper, and at the end of each month the central exchange levies an assessment against each district exchange for its approximate pro rata share of the cost, based on the number of boxes shipped. The final adjustment is made with each district exchange at the end of each year.

In 1914–15 the exchange growers shipped 11,889,836 boxes of citrus fruits. It cost the grower approximately 4¼ cents per packed box to distribute and sell the crop to 2,500 jobbers in the United States, Canada, and other foreign countries, or 1⅞ per cent of the delivered value of the fruit. They paid approximately 2 cents per box, or less than eight-tenths of 1 per cent, additional for national advertising to increase the consumption of citrus fruits and to bring

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the shippers into closer working relations with the jobbers and retail dealers. The average cost of the district exchange is .91 of 1 per cent per box, making the total average cost of the exchange and district-exchange service, including the cost of advertising, 7.16 cents per box.

Under this system the growers and shippers, through their associations and district exchanges, regulate and control their shipments; that is, they determine the conditions under which their fruit shall be sold outside of the auction markets, ship when and in any amount they please, determine to what markets the fruit shall be consigned and where it shall be sold outside of the auction markets, and designate the price they are willing to accept.

Through the agents the central exchange gathers daily information regarding the conditions of the market, secures detailed reports on the sale of every car of exchange fruit and on weather conditions, and sends this information in the form of daily bulletins to the district exchanges. These bulletins also include a catalogue of the details of exchange cars leaving California, all telegrams passing between the shipper and the agent regarding each car, several special reports from auction or private-sale markets, and at the end of each week and month summaries of the different business operations of the system.

With this information at hand, and the advice he may secure from the central office, each shipper can intelligently decide the various marketing problems for himself and thereby avoid chaotic distribution and demoralized sales.

### THE NATIONAL ADVERTISING OF CITRUS FRUITS.

The orange and lemon crops of California have increased from 5 to 20 per cent or more annually for many years. Population increases on the average 2 per cent annually, but production increases without reference to demand and without relation to the increase in population. In addition to 20,000 acres of lemons, there are 21,000 acres of Valencia oranges and 42,500 acres of the Washington navel variety, 4 years old or under, which in the next few years will double the lemon and Valencia crops and increase the Washington navel shipments.

The problem in California is to create a larger consumer demand and then to increase the efficiency of the sales efforts with the jobbers and retailers, so that oranges and lemons may be widely distributed and placed in the consumer's hands at reasonable prices. Production can not be curtailed. Whatever the groves bring forth must be sold. Sales efforts must be broad enough to move the crop under adverse as well as under normal conditions. Through a national campaign of education the growers are endeavoring to increase the consumer demand rapidly enough to keep pace with production. If the consumer demand can be increased, the problems of wholesale and retail distribution are solvable; if consumer demand is not increased commensurate with increased production, no sales efforts on the part of the jobber or the retailer can move a crop at satisfactory prices, because sales efforts do not materially increase consumption. They meet the demand which the consumer makes upon them.

The exchange is therefore gradually extending consumer advertising as the basis of its sales plans. It uses national magazines, newspapers, and trade papers in its appeal to the consumers in developing the uses of citrus fruits. It emphasizes the delicious qualities of oranges and lemons, their healthfulness, the various ways of using them, and endeavors through persistent education to develop the latent capacity of 100,000,000 people to consume citrus fruits. Primarily the function of the advertising is to increase the consumption of citrus fruits. It is not competitive advertising. To make it effective the exchange shippers pack the higher grades under trade-marked brands, because a

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brand is the consumer's guaranty of quality and is necessary around which to build up an effective educational campaign.

The exchange growers are expending $100,000 on lemon and $250,000 on orange advertising in order to create a larger public consciousness of the food value and healthfulness of citrus fruits. It has recently organized a field department to cooperate with the associations in improving the handling of the fruit, in standardizing the grading and packing, and to assist in other ways in putting the industry on a sounder basis.

The discussion in the preceding pages sets forth some of the principles and practices in the handling of the California citrus industry through the cooperation of the growers in working out their common problems. Cooperation is successful in the citrus industry because it is founded on the bedrock of necessity. The growers are an unusual class of men, representing progressive farmers from the East, lawyers, doctors, merchants, and business men who have moved West to engage in horticulture. These men are acquainted with each other. Ninety per cent of them are located in a comparatively small area in southern California. The industry has been able to develop and control its distribution through exclusive agents, because oranges and lemons are shipped from California every day in the year.

The cooperative movement has been developed by men of big vision and wide experience. They are looking into the future in developing plans for the successful perpetuation of a large industry, and they have evolved an industrial democracy which has been the most powerful factor in building up a splendid California rural life.

## Adjournment.

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## JOINT SESSION OF SUBSECTIONS 1, 2, AND 3 OF SECTION VII WITH SUBSECTION 1 OF SECTION III.[1]

RALEIGH HOTEL,
*Tuesday afternoon, January 4, 1916.*

Chairman, M. R. CAMPBELL.

Papers presented:

Conservation of Iron Ore, by C. K. Leith. (Section III, subsection 1.)

Fuel Situation in the Andean Plateau, by Benjamin L. Miller and Joseph T. Singewald, jr. (Section VII, subsection 1.)

Practical Difficulties of Conserving Our Fuel Supply, by J. S. Burrows. (Section III, subsection 1.)

The Saving of Coal Through the Employment of Better Mining Methods, by Frank Haas. (Section III, subsection 1.)

Metallurgy at Braden, by Bernard T. Cooley and Ross E. Douglas. (Section VII, subsection 2.)

Metallurgy Operations at Chuquicamata, by E. A. Rose. (Section VII, subsection 2.)

Recent Progress in Metallurgical Practice in Peru, by Miguel Fort. (Section VII, subsection 2.)

Conservation of Phosphate Rock in the United States, by W. C. Phalen. (Section VII, subsection 3.)

Phosphate Resources of the United States, by George R. Mansfield. (Section VII, subsection 3.)

[1] The papers and report of this session are found in Vol. VIII, Section VII, of the Proceedings of the Second Pan American Scientific Congress.



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## JOINT SESSION OF SUBSECTIONS 5 AND 6 OF SECTION III.

RALEIGH HOTEL,
*Tuesday afternoon, January 4, 1916.*

Chairman, B. H. RAWL.

The session was called to order at 2.30 o'clock by the chairman.

Abstracts of the following papers were read by the corresponding secretary, Mr. C. W. Sutton:

Catálogo de los peces pertenecientes a la fauna de Guatemala, by Juan J. Rodríguez Luna.

Conservación de las plantas industriales, by Rafael Piñol Batres.

El manganeso en la capa arable del Uruguay, by J. Maimo Sarrasín.

### CATÁLOGO DE LOS PECES PERTENECIENTES A LA FAUNA DE GUATEMALA.

Por JUAN J. RODRÍGUEZ LUNA,
*Entomólogo, Guatemala, Guatemala.*

A medida que la importante obra "Biología Centrali-Americana" terminaba los estudios referentes a las clases de animales vertebrados, fuí haciendo un extracto de las especies que corresponden a Guatemala, y cuya existencia en el territorio de esta República se había comprobado por la observación directa de naturalistas que estuvieron aquí, o por envíos de ejemplares recogidos en este país por personas competentes. Incluí también en los extractos aquellas especies no señaladas para Guatemala, pero sí para México y a la vez para los países que están al sur de aquélla, porque siendo Guatemala zona intermedia y cercana, es casi indudable que también le corresponden.

El catálogo que formé de los Mamíferos se publicó en folleto; el de las Aves, en el periódico guatemalteco "El Heraldo" (Tomo I, N°. 7, etc.), y el de los Reptiles y Batracios por el V° Congreso Médico Pan-Americano, al cual fué dedicado por la utilidad que reporta el conocimiento de los ofidios venenosos de este país. Los referidos catálogos fueron reproducidos todos por el importante boletín "Anales del Museo Nacional de El Salvador."

Fuera de lo apuntado sólo ha visto la luz la lista de los Miriapodos, clase Artropodos, tanto porque es corta, cuanto porque muchas de las especies son exclusivamente de Guatemala. La remití al IV° Congreso Científico (y Pan-Americano) celebrado en Santiago de Chile, y fué acogida y publicada. (Vol. XVII, pág. 93.) Aun no ha sido reproducida en Guatemala.



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Los catálogos de Arácnidos, Crustáceos y Hexápodos llenarían volúmenes enteros con sus innumerables especies conocidas, que figuran en más de veinte grandes tomos de la Biología Centrali-Americana, en los cuales aparecen como autores más de treinta competentes naturalistas ingleses, suizos y americanos. En este particular sólo es factible hacer listas parciales, para dar a conocer los nombres científicos de ejemplares existentes en colecciones, y que tendrían que ir adicionándose continuamente, y cuya publicación, cuando esas colecciones fuesen de particulares y no de museos públicos, no tendría objeto.

En el importante tipo de los Vertebrados sólo me falta dar o conocer la clase Pisces. Terminóse el trabajo de ella, en la monumental obra citada, durante el año de 1908 y lo llevó a cabo el ictiólogo Sr. C. Tate Regan. Le corresponde un tomo que, sin contar la introducción, tiene 203 páginas, 26 láminas y 2 cartas geográficas de la sub-Región Centro-Americana, que demuestran la distribución de las diferentes especies de agua dulce y marítimas.

Se contó para la obra con abundante material de individuos de todos los países de la sub-región, con vastas colecciones de varios museos, muy ricas bibliotecas y abundante literatura.

La introducción del libro del Sr. Tate Regan, que abraza xxxiii páginas, es sumamente instructiva y merecería ser vertida al castellano; y si se publicara con el catálogo que he formado le comunicaría gran interés pues los datos y grabados que contiene son de mucha importancia y dan a conocer los puntos de contacto y las divergencias que existen entre la fauna de la América tropical y la de las otras regiones de este continente, así como del Antiguo Mundo. La distribución de las especies debe obedecer a causas que, como otras muchas materias biológicas, son hoy casi desconocidas, y que presentan ancho campo para la investigación, en el cual los hombres estudiosos y observadores buscan y seguirán buscando, hasta encontrarlos, los secretos de la naturaleza.

Es probable que después de 1908 hayan sido encontradas nuevas especies que habiten dentro de los límites geográficos de la República de Guatemala o en los otros países que con ella constituyen la sub-Región Centro-Americana, correspondiente a la Región Neo-Tropical. Esas nuevas especies o las que en lo porvenir se descubran pueden ser anotadas en los lugares debidos para mantener la lista al día.

Usaré en el siguiente Catálogo de Peces el mismo método que emplee en los otros, marcando con:

N., las species que se extienden al norte de Guatemala.
S., las que continúan al sur.
M., las que sólo llegan a México.
P., las que alcanzan hasta Panamá.
Atlant., las que se hallan en el océano Atlántico.
Pacif., los que habitan el Pacífico.
L., significa lago o laguna.
R., es Río.

Los pocos nombres vulgares generalmente usados que conozco serán puestos en notas. Hay muchos otros, pero son de idiomas indígenas o sólo se usan en puntos determinados.

VERTEBRATA.

Classis: Pisces. Sub-Class: Teleostomi. Order: Teleostei. I. Sub-Ord.: Acanthropterygii.

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*I. Familia: Pleuronectidæ.*

1. *Citharichthys gilberti*, Jenkis & Evermann---- [1]N. S. Pacif.
2. *Achirus fonsecensis*, Günther---------- [2]N. M. Pacif.

*II. Familia: Gobiesocidæ* (Caret).

*III. Familia: Gobiidæ.*

3. *Philypnus dormitator*, Cuvier & Val-------- [3]N. Atlant.
4. *Philypnus maculatus*, Tate Regan---------- N. S. Pacif
5. *Eleotris guavina*, Cuv. & Val---------- M. S. Atlant.
6. *Eleotris pisonis*, Schneider---------- M. S. Atlant.
7. *Eleotris picta*, Kner & Steind---------- N. S. Pacif.
8. *Dormitator maculatus*, Jord. & Gilb-------- [4]M. Atlant.
9. *Dormitator latifrons*, Elgenm. & Fordice---- N. S. Pacif.
10. *Chonophorus banana*, Regan---------- N. S. Atlant.
11. *Gobioides broussonetti*, Lacepede---------- M. S. Atlant.

*IV. Familia: Carangidæ.*

12. *Scombroides palometa*, Regan---------- [1]S. Atlant. (L. Izabal).

*V. Familia: Cichlidæ.*

13. *Cichlosoma maculicauda*, Regan---------- [5]S. Atlant. (L. Izabal).
14. *Cichlosoma guttulatum*, Günther---------- [5](L. Amatitlán, etc.).
15. *Cichlosoma microphthalmus*, Günth-------- [5](Río Motagua).
16. *Cichlosoma melanurum*, Regan---------- [5](L. del Petén).
17. *Cichlosoma anguliferum*, Günth---------- [5](Cahabón).
18. *Cichlosoma intermedium*, Günth---------- [5](L. del Petén).
19. *Cichlosoma godmani*, Günth ---------- [5](Río Cáhabón).
20. *Cichlosoma irregulare*, Günth---------- [5](L. Izabal, R. Usumacinta).
21. *Cichlosoma nigrofasciatum*, Günth-------- [6](L. de Amatitlán).
22. *Cichlosoma spilurum*, Günth---------- [5](Motagua, L. Izabal).
23. *Cichlosoma immaculatum*, Pellegr.---------- [5](R. Polochic).
24. *Cichlosoma spinosissimum*, Vaill. & Pellegr. [5](R. Polochic).
25. *Cichlosoma macracanthus*, Günth---------- [5](Huamuchal).
26. *Cichlosoma margaritiferum*, Günth-------- [5](Guatemala).
27. *Cichlosoma aureum*, Günth---------- [5]M. (L. Izabal, R. Motagua).
28. *Cichlosoma affine*, Günth---------- [5](L. del Petén).
29. *Cichlosoma trimaculatum*, Günth---------- [5]M. (Huamuchal).
30. *Cichlosoma salvini*, Günth---------- [5]M. (L. Petén, R. Cahabón).
31. *Cichlosoma multifasciatum*, Regan---------- [5]Belice (L. Petén).
32. *Cichlosoma friedrichstanli*, Heck---------- [5](L. del Petén).
33. *Cichlosoma motaguense*, Günth---------- [5](R. Motagua).
34. *Petenia splendida*, Günth. (1862)---------- (L. Petén).
35. *Herichthys bocourti*, Vaill. & Pell. (1902)--- (L. Izabal).
36. *Herichthys geddesi*, Regan---------- M.

[1] *Lenguado, Pejecaite.*
[2] *Peje caite.*
[3] *Bobo.*
[4] *Roncador.*
[5] *Mójarra* (de Mojarra, que es hierro de lanza).
[6] *Chirica.*



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*VI. Familia: Sciænidæ.*

37. *Haploidonotus Grunniens*, Rafin..... N. (R. Usumacinta).

*VII. Familia: Percidæ* (Caret).

*VIII. Familia: Centrarchidæ* (Caret).

*IX. Familia: Liognathidæ.*

38. *Gerres cinereus*, Regan..... N. S. Atlant.
39. *Gerres simillimus*, Regan..... [1]N. S. Pacif.
40. *Gerres gula*, Cuv. & Val. (1830)..... N. S. Atlant.
41. *Gerres harengulus*, Goode & Bean..... [2]N. S. Atlant.
42. *Gerres californiensis*, Gill..... [2]N. S. Pacif.
43. *Gerres peruvianus*, Cuv. & Val. (1830)..... [2]M. S. Pacif.
44. *Gerres axillaris*, Günth..... [3](Chiapán Guatemala).
45. *Gerres plumieri*, Cuv. & Val..... [2]N. S. Atlant. (L. Izabal).
46. *Gerres brevimanus*, Günth..... [2]N. S. Pacif. (Chiapán).

*X. Familia: Pomadasidæ.*

47. *Pomadasis leuciscus*, Jord. & Gilb..... [2]N. S. Pacif. (Chiapán).
48. *Pomadasis macracanthus*, Jord. & Ferler..... [2]N. S. Pacif. (Chiapán).
49. *Pomadasis branicki*, Jord. & Feilen..... [2]M. S. Pacif.
50. *Pomadasis boucardi*, Regan..... [2]M. S. Atlant.
51. *Pomadasis crocro*, Jord. & Ferler..... [2]N. Atlant. (R. Motagua).

*XI. Familia: Centropomidæ.*

52. *Centropomus pectinatus*, Poey..... [2]N. S. Atlant.
53. *Centropomus medius*, Günth..... [2]N. S. Atlant.
54. *Centropomus parallelus*, Poey..... [2]N. S. Atlant., Pacif.
55. *Centropomus undecimalis*, Cuv. & Mals..... [2]N. S. Atlant.
56. *Centropomus viridis*, Lockington..... [2]N. P. Pacif.
57. *Centropomus nigrescens*, Günth..... [2]M. P. Pacif. (Chiapán).
58. *Centropomus robalito*, Jord. & Gilb..... [2]M. P. Pacif. (Chiapán).
59. *Centropomus ensiferus*, Poey..... [2]M. S. Atlant.
60. *Centropomus unionensis*, Bocourt..... [2]P. Pacif.

II. Sub-Ord: Lophobranchii.

Fam: Syngnathidæ.

61. *Syngnathus auliscus*, Swain..... [4]N. P. Pacif.

III. Sub-Ord: Percesoces.

*I. Familia: Atherinidæ.*

62. *Thyrina guatemalensis*, Jord. & Cuv..... [5]M. Pacif. (Huamuchal).

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[1] *Palometa* (?).
[2] *Boca colorada.*
[3] *Rebalo* (?).
[4] *Caballito de mar—Hipocampo.*
[5] *Lisa?*

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*II. Familia: Mugilidæ.*

63. *Agonostomus nasutus*, Jord. & Ever..... [1]M. P. (Montagua).
64. *Agonostomus salvini*, Regan..... (R. Nacasil).
65. *Agonostomus macranthus*, Regan..... [1]Pacif. (R. Guacalate).
66. *Joturus pichardi*, Poey..... [2]M. P. Atlant.
67. *Mugil cephalus*, L..... [3]N. S. Atlant., Pacif.
68. *Mugil thoburni*, Jord. & Stark..... S. Pacif.
69. *Mugil curema*, Cuv. & Val..... N. S., Atlant., Pacif.
70. *Mugil hospes*, Jord. & Culver..... M. P. Pacif.
71. *Mugil trichodon*, Poey..... N. S. Atlant.
72. *Querimana harengus*, Günth..... M. S. Pacif.
73. *Chenomugil proboscideus*, Günth..... M. P. Pacif.

*III. Familia: Sphyrenidæ* (Caret).

(Tota sec. Reg.)

*IV. Familia: Polynemidæ* (Caret).

(Tota sec. Reg.)

IV. Sub-Ord: Haplomi.

*I. Familia: Scombresocidæ* (Caret).

(Guatemala.)

*II. Familia: Ciprinodontidæ.*

74. *Fundulus pachycephalus*, Günth..... [4](L. Atitlán).
75. *Fundulus punctatus*, Günth..... [5]M. S. (R. Guacalate, L. Amatitlán).
76. *Fundulus labialis*, Günth..... [4](R. Chixoy, L. Izábal).
77. *Rivulus godmani*, Regan..... [4](Guatemala sólo).
(Nota.—Faltan los gen. *Cyprinodon*, *Zoogoneticus*, *Limnurgus*, *Charodon*, *Goodea* que existen en México.)
78. *Belonesox belizanus*, Kner..... M. (L. del Petén).
79. *Gambusia nicaraguensis*, Günth..... M. Nicaragua, Atlant.
80. *Gambusia bimaculata*, Regan..... [2]M. Atlant.
81. *Gambusia fasciata*, Meek..... [2]M. Pacif. (Caballo Blanco).
82. *Girardinus Lutzi*, Regan..... [2]M. Atlant. (R. Motagua).
83. *Girardinus pleurospilus*, Günth..... [3](L. Dueñas, Nacasil).
84. *Pœcilia spilurus*, Günth..... [3](Centro América).
85. *Pœcilia sphenops*, Cuv. & Val..... [5]M. S. Pacif. (L. Dueñas).
86. *Pœcilia petenensis*, Günth..... [3](L. del Petén).
87. *Mollienesia petenensis*, Günth..... (L. del Petén).
88. *Xiphophorus guenthèri*, Jord. & Ever..... (R. Chipoy).
89. *Anableps dovii*, Günth..... M. Pacif. (Chiapán).

V. Sub-Ord: Apodes.

*I. Familia: Anguillidæ.*

90. *Anguilla chrysipa*, Rafin..... [4]M. S. Atlant., Pacif.

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[1] *Tepemachin.*
[2] *Ulumina.*
[3] *Ulumina-Pescadito Fripon.*
[4] *Anguila.*

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*II. Familia: Muræniдæ* (Caret).

VI. Sub-Ord: Symbranchi.

*I. Familia: Symbranchidæ.*

91. *Symbranchus marmoratus*, Günth ..... M. S. Pacif.

VII. Sub-Ord: Ostariophysi.

*I. Familia: Loricariidæ.*

(Caret. Div. genera Sud America.)

*II. Familia: Siluridæ.*

92. *Ælurichthys filamentosus*, Regan ..... [1]M. Nic. Atlant.
93. *Ælurichthys pinnimaculatus*, Steind..... [1]M. S. Pacif.
94. *Galeichthys troscheli*, Regan ..... [1]M. P. Pacif.
95. *Galeichthys planiceps*, Regan..... [1]M. P. Pacif.
96. *Galeichthys kessleri*, Regan ..... [1]M. P. Pacif.
97. *Galeichthys platypogon*, Regan..... [1]M. S. Pacif.
98. *Galeichthys guatemalensis*, Günth ..... [2]M. (Chiapán) Pacif.
99. *Galeichthys cœrulescens*, Jord. & Everm..... [2]M. Pacif. (Huamuchal).
100. *Galeichthys seemani*, Jord. & Everm ..... [2]M. S. Pacif.
101. *Galeichthys guentheri*, Regan ..... [2]M. Atlant.
102. *Galeichthys peruvianus*, Lütk ..... [2]M. S. Pacif.
103. *Arius melanopus*, Günth ..... [3]M. Atlant. (R. Motagua).
104. *Rhamdia parryi*, Eigenm ..... [3]M. Atlant.
105. *Rhamdia motaguensis*, Jord. & Everm..... [3]M. Atlant. (R. Motagua).
106. *Rhamdia petenensis*, Jord. & Everm..... [3](L. del Petén).
107. *Rhamdia guatemalensis*, Jord. & Everm ..... [3]M. Pacif. (Huamuchal).
108. *Rhamdia godmani*, Jord. & Everm ..... [3]M. Atlant. (R. Motagua).
109. *Rhamdia microptera*, Jord. & Everm ..... [3](R. San Jerónimo).
110. *Rhamdia brachycephala*, Regan..... [3](R. Nacasil).
111. *Rhamdia salvini*, Jord. & Everm ..... [3](R. San Jerónimo).
112. *Rhamdia polycaulus*, Jord. & Everm ..... [3](R. San Jerónimo).
113. *Rhamdia cabrerce*, Meek ..... [3](L. Amatitlán).
114. *Conorhynchus nelsoni*, Everm. & Gohl..... [3](R. Usumacinta).
115. *Amiurus meridionalis*, Günth ..... [3]M. Atlant. (R. Chixoy).

NOTA.—Hay once especies más que Regan anota sólo para México. Quizá algunas pertenezcan también a Guatemala.

*III. Familia: Cyprinidæ.*

116. *Ictiobius meridionalis*, Jord. & Everm..... M. (R. Usumacinta).

NOTA.—Sólo para México aparecen en la obra de Regan los géneros: ***Mocostoma, Catostomus, Xiranchen, Abramis, Campostoma, Hybognathus, Algansea, Lencisous, Falcula, Notropis, Evarra, Phenacobius, Xystrosus, Stypodon, Yuriria, Cuesius, Stybopsis, Agosia, y Rhinichtys.*** Es probable que se encuentren en Guatemala y por falta de estudios y de pesquerías en sus ríos y mares adyacentes no se hayan descubierto.

[1] *Bagre, Zunte, Juilín.* [2] *Bagre Juilín.* [3] *Juilín.*

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*IV. Familia: Characinidæ.*

Los géneros *Hoplias*, *Piabucina*, *Luciochara*, no aparecen citados sino para Panamá. Es posible que se hallen en Guatemala.

117. *Bricon guatemalensis*, Regan_____ (R. Chixoy, R. Motagua).
118. *Tetragonopterus æneus*, Günth_____ [1]M. (L. Amatitlán, etc.).
119. *Tetragonopterus mexicanus*, Filippi_____ [1]M. (R. Chixoy, L. Petén, etc.).

Los géneros *Chirodon*, *Gastropelecus*, *Bromocaræ*, de México y Nicaragua no aparecen con representantes en Guatemala.

120. *Rœboides guatemalensis*, Jord. & Everm_____ M. S. Pacif. Huamuchal).

*V. Familia: Gymnotidæ.*

121. *Giton fasciatus*, Jord. & Everm_____(R. Motagua, L. Amatitlán).

VIII. Sub-Ord: Malacopterygii.

*I. Familia: Salmonidæ* (Caret).

*II. Familia: Clupeidæ.*

122. *Dorosoma petenense*, Jord. & Everm_____ (L. del Petén).
123. *Anchovia macrolepidota*, Jord. & Everm_____ M. S.

*III. Familia: Chanidæ* (Caret).

*IV. Familia: Elopidæ* (Caret?).

IX. Sub-Ord: Ginglymodi.

*I. Familia: Lepidosteidæ.*

124. *Lepidosteus tropicus*, Jord. & Everm_____ [2]M. Nicaragua Pacif. (Huamuchal).

II. Sub-Class: Selachii.

I. Order: Euselachii. I. Sub-Ord: Pleurotemata.

*I. Familia: Charchariidæ.*

125. *Charias nicaraguensis*, Jord & Everm_____ [3]N. S.

II. Sub-Ord: Hipotremata.

*I. Familia: Pristidæ.*

126. *Pristis pectinatus*, Latham_____ [4]M. S. Atlant., Pacif.
127. *Pristis perrotteti*, Müll. & Heuler_____ [4]M. S. Atlant., Pacif.

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[1] Pepesca. [2] *Peje armado.* [3] *Raya.* [4] *Peje-sierra.*

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## CONSERVACION DE LAS PLANTAS INDUSTRIALES.

Por RAFAEL PIÑOL BATRES,

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Sin prescindir de los Estados Unidos, que siguen siendo un país agrícola, a pesar del gran incremento con que sus vastas industrias hace tiempo que están desarrollándose, todas las Repúblicas de América tienen su mejor fuente de riqueza en la agricultura; y cada nación, comprendiéndolo, ha procurado mejorar el sistema de cultivo de aquellas plantas que le suministran productos exportables y que con mayor o menor facilidad se dan en su suelo.

Toca a los Estados Unidos y a la Argentina el primer lugar en el cultivo de los cereales y suministrando dichos importantes países el precioso grano a muchos de los mercados de Europa y de la América, han llevado el cultivo del primer cereal a un punto ya cercano a la perfección.

En la diversidad de climas y terrenos del continente americano, claro está que hay otros países en los cuales este cultivo podría efectuarse, si no en escala que permitiera exportar la dorada mies, sí en grado suficiente para llenar las necesidades internas; y logrado que fuese que cada país de América produjera el trigo necesario para su consumo, no con eso habrían de perjudicarse las naciones al principio citadas, pues no faltan en el mundo mercados que consumieran la producción que dejara de introducirse en las Repúblicas americanas que hoy lo consumen importándolo.

No con la importancia del trigo, pero si en grado inmediato inferior, otro tanto puede decirse del maíz y de las otras gramíneas, cebada, avena, centeno, cuyo cultivo juntamente con el del trigo, se trabaja de manera tan acabada en los Estados Unidos y la Argentina.

Hace falta en los países productores en pequeña escala de dichas gramíneas y en aquellos que teniendo suelos y climas apropiados, para llevarlos a cabo, no lo han hecho aún, difundir en las masas el conocimiento de la manera de producirlas y dar a conocer la maquinaria indispensable para efectuar los trabajos de manera científica, fácil y racional.

Aquí se presenta la oportunidad para los países americanos, que a más de ser agrícolas son también industriales, de abrir mercados para sus manufacturas de maquinarias, etc., a cambio de un beneficio recíproco. Para lograrlo hay que aprovechar la oportunidad que la guerra europea da a la América, y es el momento que, dándose a conocer las mutuas necesidades, unas en otras, las Repúblicas de este Continente busquen lo que han menester.

A la caña de azúcar, la falta de competencia de la remolacha, le ha devuelto al presente si no toda, acaso algo de la importancia que tuviera. Se ha circunscrito su cultivo a aquellas zonas muy privilegiadas y tiende a irse unificando su producción en ingenios centrales para poder lograr los productores mayor utilidad, merced a las grandes cantidades que benefician. Ya es sabido que no hay otro alimento que requiera maquinaria tan costosa y complicada para su elaboración y de allí que habiéndosele hallado sustitutos, el cultivo de la caña de azúcar, como artículo de exportación, no haya tenido el incremento de otras plantas.

Cada República de América produce diversidad de frutas, y su consumo se procura llevarlo fuera, logrando volverlas artículos de exportación que aumenten la riqueza nacional. Diseminadas cada una en su altitud—ordenada la naturaleza—las reparte en análogas condiciones tanto al sur como al norte del Ecuador y así vemos que aquellas deliciosas que han formado la riqueza del oeste de los Estados Unidos, son en Chile y parte de la Argentina, motivo de extensos cultivos que dan rendimientos apreciables.

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Pero si dichas frutas no pasan de diez clases, hay que considerar que el trópico guarda más de sesenta variedades, todas comestibles, y algunas quizás de mejor sabor y más apreciables condiciones alimenticias que las primeras.

No hay que buscar en el mediodía de la Europa la buena producción del género *citrus*. Hay secciones en las Repúblicas de la América que lo producen tan bien como allende el Atlántico y no hace falta sino fomentar el cultivo y buscarle salida en los mercados, para obtener una nueva fuente de lucro.

¡El banano! Basta ver el asombroso desarrollo que ha tomado su cultivo, merced al inmenso consumo que se inicia, para considerar la importancia de la producción de fruta tan útil ¡y téngase en consideración que de las frutas tropicales es acaso el banano de las más delicadas para conservarse fresca!

Ha sido la poderosa mano norteamericana la que ha llevado a las suntuosas mesas de Europa tan regalada golosina, dándola a conocer antes en sus vastos mercados y al cabo de breves años, países como Costa Rica, Honduras, Guatemala, Venezuela y algunos de las Antillas, ven en el banano una nueva fuente de riqueza, proporcionando a los consumidores un manjar nutritivo y agradable.

Las Repúblicas del Sur de América si no logran producir en sus terrenos, propios para el caso, tan deliciosa fruta, ocasión tendrán de recibirla cuando la facilidad de comunicaciones que ha dado a la América la apertura del Canal de Panamá, abrevie las distancias!

De las innumerables frutas del trópico, fuera del banano, el aguacate, la piña y el coco (éste de tanta importancia industrial) las demás no se conocen y motivo de lucro cierto, sería el iniciar un comercio con las demás Repúblicas americanas u otros mercados, llevándoselas ya frescas, ya conservadas en su jugo.

Por lo que a Guatemala atañe, hay ya compañías con ese objeto que han principiado a dar a conocer primero en los Estados Unidos, para después hacerlo en las Repúblicas del Sur, las mejores variedades de frutas frescas o en conserva que se producen en esta sección del Istmo centroamericano.

En el Brasil y Cuba la guayaba es artículo de exportación, y el auge que han tomado las compañías que la trabajan es certidumbre eficaz de la riqueza comercial de este nuevo venero agrícola.

En las frutas, pues, tienen las Repúblicas Americanas un producto importantísimo. Falta el intercambio de conocimientos y que, experimentándose los mercados, cada país impulse el cultivo de todas aquellas que puede hacer consumir en países extraños.

Lo que de las frutas queda dicho, aseverarse puede de las nueces y de las plantas oleaginosas. Los países industriales de la América pueden hallar en las otras Repúblicas del Continente las materias primas que necesiten. No falta sino dar a conocer en cada una de ellas los productos que hubieren menester, para que se inicie en lugares a propósito, el cultivo de todos aquellos árboles, arbustos, etc., ricos en aceites, gomas y recinas.

Hay variedades que producen cauchos, que no se conocen! Hay otras mal trabajadas y por consiguiente de escaso valor comercial y así como el guayule fué descubierto por la casualidad y es ya motivo de comercio en México, y algunas zonas del Perú, Brasil y otras Repúblicas del Sur ¡cuántas nuevas plantas podrían dar al mercado, la riqueza de sus gomas, el perfume de sus aceites, la tintura de sus hojas o de sus secreciones!

Las plantas textiles—patrimonio del México del Sur—seguirán su amplio desarrollo con el advenimiento de la paz en aquella desangrada República; y con la experiencia del cultivo del henequén (el improvisador de fortunas) no hay duda que se iniciará la propagación de nuevas plantas que rindan la utilidad de sus fibras. Inútil ponderar la importancia del algodón. Hasta

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el más ignorante palurdo comprende los infinitos servicios que prestan sus delgados hilos. ¡En estos supremos instantes qué no diera Alemania por tenerlo cultivado en su suelo! Pues bien, el algodón, en sus diversas variedades, casi no hay país americano en donde no se produzca o pueda producirse.

Es el cacao originario de la tierra de Colón. ¿Porqué tanto se falsifica con perjuicio de los productores? Por el aislamiento de las naciones que lo producen. Es indispensable para terminar tan perjudiciales fraudes la ayuda de los países consumidores y logrando que no haya mistificaciones en los mercados, el cacao, será cacao y los cultivos se ensancharán para dar abasto a la demanda cada día más grande de la inapreciable almendra cuajada en urna de coral!

Encierra la flora americana un sinnúmero de plantas medicinales, conocidas unas y muchas que guardan en secreto sus inapreciables virtudes. Crecen las unas, al natural, sin cultivo; y cuántas solo aguardan que la voz del naturalista haga públicas sus cualidades curativas y que el agricultor inteligente las propague, dándolas a conocer, produciendo con ellas beneficio a la humanidad doliente y un nuevo manantial de negocio. Y es de hacerse notar que los bosques inexplorados, aún abundan en territorio americano y que deber del patriotismo y de la ciencia de los intelectuales de este continente, es desentrañar los misterios que guardan en su seno tanta variedad de árboles y plantas dignos de que los hombres se familiaricen con sus valiosas propiedades.

Para cerrar esta somera enumeración de las principales plantas útiles a la humanidad bajo diferentes aspectos y cuyo cultivo debe proseguirse, ensancharse, mejorarse o iniciarse, según el provecho que rindan, voy a hablar del café, por ser la principal fuente de riqueza de mi país. En la Exposición Universal de San Francisco, Guatemala tuvo la honra de llevarse el primer premio por la supremacía de las variedades de café que produce.

El café como artículo alimenticio ha entrado ya a formar parte de las necesidades de la humanidad y sus excelentes atributos como estimulante del sistema nervioso y como digestivo sin rival, son de todos conocidos, para hacer hincapié en ellos.

Su cultivo es motivo de acuciosos trabajos que han dado lugar a que se coseche de inmejorables cualidades y sabores; y su beneficio, hasta ponerlo en oro, como vulgarmente se llama, nada deja que desear. Ahora bien; el grano de café limpio por tener que pasar por muchos intermediarios, no puede llegar a poder del consumidor sin manipuleos y de allí las adulteraciones y las mezclas que rebajan su aroma, cualidad alimenticia y delicado sabor. En el interés de los productores, que su grano se consuma, sin mengua de las altas propiedades que contiene y de una manera racional, fácil y limpia, se han hecho por diversos hombres de ciencia de mi país, estudios minuciosos y se ha logrado el desideratum, es decir, que el café pueda llegar café puro a la boca del consumidor.

El beneficio del café, si ha logrado antes de ahora completa perfección hasta poner el grano limpio, dejaba la operación a medias; verbi gracia: como si el trigo se entregara al consumidor, sin convertirlo en harina. Hay en el trigo, el salvado y las diferentes harinas. Para la fabricación del pan, claro está que se emplea la harina de primera, la flor, y los demás residuos se dejan para otros usos.

En el grano de café hay materias alimenticias, es decir: grasas, aceites volátiles, cafeína, cafeona, etc., y hay residuos de madera, que forman una hez que no puede utilizarse como alimento.

En la actualidad, el café en grano es mezclado al estar limpio con granos de inferior calidad, por la serie de traficantes por los que pasa, entre el productor y el consumidor. Mezclado ya, en diversas proporciones llega a las

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tostadurías y aquí hay la nueva adulteración de achicoria, cereales, etc. El polvo del café ya tostado, va a los vendedores y de aquí al consumidor, que tiene que preparar la esencia, para beberse ésta, mezclada con agua o leche. Después de tanta mano que lo ha tocado en tan largo peregrinaje, después de su más o menos acertada destilación, del café no llega a la boca del consumidor, sino una triste sombra de lo que es! Quizás sus mejores cualidades alimenticias, su aroma exquisito y su delicado gusto perdiéronse en el camino!

El modernísimo tratamiento que se da al café, completando su beneficio, lo transforma actualmente en un polvo perfectamente soluble en el agua o la leche, en frío o en caliente, que se presenta al consumidor de igual manera que el azúcar. De este modo, cualquiera puede hacer su café a su entero gusto. Basta echar en la taza una cucharadita del polvo, que instantáneamente se disuelve sin dejar el menor residuo, para producir un café de primera, siempre uniforme, siempre aromático, siempre nutritivo.

El procedimiento consiste en separar del grano ya limpio, todas las materias alimenticias de la parte no comestible, consistente en madera. Exactamente como se hace con el trigo en los molinos! La parte utilizable que se logra concentrar íntegra, sin desperdicio alguno, queda reducida a un polvo seco, granulado, que se entrega a la venta, sin poner en manos del consumidor materias inútiles.

Salta a la vista del menos observador las incalculables ventajas del nuevo invento del inteligente Doctor guatemalteco don Federico Lehnhoff Wyld. Por dicho Doctor fueron también inventadas las maquinarias para la elaboración del café soluble, que explota ya en gran escala la Compañía propietaria de tan maravillosa invención. Con el nombre de café "Belna" ha empezado a revolucionar los mercados de Europa. Hay una fábrica establecida en Bruselas, otra en Paris y la tercera, que pensaba fundarse en Estados Unidos o Brasil no ha podido implantarse, por los trastornos acarreados por la guerra. Está ya en Alemania concluida la maquinaria respectiva. El producto es inmejorable y tanto en Alemania con el nombre de "Cefabú Caffe" como en Estados Unidos bajo el nombre de "Washington Coffee," se venden productos similares, aunque inferiores al "Belna."

La desconfianza natural que en el público despierta todo producto nuevo, ha principiado muy lentamente a destruirse. El inveterado modo de preparar el café se cambia de manera radical y toda innovación, cuesta trabajo introduciria. La rutina es dura para vencerse, pero ante las inmensas ventajas de economía, pureza y facilidad, el camino se andará y en breve tiempo el uso del café soluble habrase impuesto en el mundo.

El público está acostumbrado a beber bajo el nombre de café, algo que de café no tiene sino rastros. Un brevaje más o menos amargo que no contiene las condiciones aromáticas y menos alimenticias del producto que sale de las plantaciones. El gusto por tal brevaje ha cundido y es claro que si a una persona habituada a él, se le presenta una taza de legítimo café, no lo acepta por tal. Con mayor razón si se le presenta bajo la forma de un polvo seco, granulado, para que ella misma se lo prepare instantáneamente. Su admiración será grande, pero desde luego piensa en que es un producto fabricado sintéticamente; alguna combinación química. Para obviar tal inconveniencia de manera gradual y como un medio de ir acostumbrando a las masas a beber buen café, estúdiase con detenimiento la materia y se ha adoptado por un grupo inteligente de productores de mi país, el sistema de hacer llegar al consumidor, el café tostado en las mismas plantaciones y convenientemente empacado en latas cerradas. Tiene este sistema la gran superioridad de que el café, que se pone en manos del que lo ha de tomar, es legítimo café; y el cierre hermético del envase, conserva todo el aroma y los aceites volátiles tan fáciles de evaporarse;

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evitando, a la vez, las adulteraciones. Por otra parte, el café de superior calidad, no es rebajado con mezclas de clases ínfimas y no se engaña al consumidor dándole gato por liebre. Para su última preparación (destilar la esencia) se sigue aún el sistema conocido de las cafeteras.

En los Estados Unidos está ya a la venta el café de Guatemala bajo el nombre de "Todo" porque en realidad se han conservado en él todas las riquezas alimenticias que encierra.

Aún a riesgo de involucrar en este trabajo, algo del Punto VII de esta misma sección, diré unas cuantas palabras acerca de la conveniencia que a los países cafeteros dará el propagar el uso del café. La colosal empresa de valorización del café del Brasil ha puesto de su parte cuanto ha tenido a su alcance para mejorar el precio del precioso grano. Mas si la producción excede a la demanda, la ley económica se cumplirá y el precio irá siempre a menos. Ha habido empeño en aumentar el consumo y precisamente por presentar el grano—al que se quiere que lo beba—sin una elaboración completa, no se consigue éxito en la propaganda que se hace, buscando nuevos mercados.

Volviendo a la referida comparación con el trigo, pregunto: ¿Se consumiría en el mundo la cantidad de trigo que se consume si cada uno que come pan tuviera que separar del grano, el alimento de los residuos? Claro que no. La elaboración del trigo es acabada. La harina es perfectamente comestible. El grano de café que se pone a la venta, no.

Si ya se resolvió el problema de separar del café, bajo forma de polvo perfectamente soluble, el alimento de la hez, dando con este útil descubrimiento el gran paso hacia la facilidad del consumo, no queda sino vulgarizar el descubrimiento, instalando los beneficios que se requiera y lanzarse a la conquista de nuevos mercados presentando un café uniforme, un café puro, un café más barato (el aprovechamiento sin desperdicios de la parte alimenticia, permite reducir el precio de venta) y un café, en fin, que cualquiera puede tomar a su gusto preparándolo de la manera más facil, cómoda, expedita y rápida. No hay duda que el café, bajo forma soluble instantánea, es el café del porvenir.

La poca, mejor dicho, la ninguna comunicación que existe entre los países productores, retarda toda evolución que deba hacerse y no hay palabras con que encomiar las ventajas que resultarían de un intercambio de estudios y resoluciones sobre puntos de tan alta importancia.

No sólo sobre la debida preparación del café, en el sentido de facilitar su consumo, presentando al público en toda su eficiencia la parte alimenticia del grano, sino acerca de un sinnúmero de cuestiones relacionadas con todos los cultivos de las plantas y preparación de los productos, hace falta que se cambien impresiones entre sí las Repúblicas Americanas. Para ello era necesario antes, simplificar las cuestiones relativas a las necesidades de mejorar el laboreo de las tierras, mediante la maquinaria apropiada; y dar a conocer las necesidades de cada país y las plantas nuevas que puedan entrar al acervo de todas aquellas que forman la riqueza de la humanidad.

Esta labor puede y debe hacerse por cada país en estaciones agronómicas, en granjas experimentales, situadas en lugares apropósito de cada nación, según la altitud, clima, terrenos y demás condiciones metereológicas. Hay países de la América que las tienen constituídas de manera perfecta. Hay otros en que no rinden los frutos apetecidos y hay algunos en que aún no existen. Si todas ellas funcionaran bajo el mismo adecuado plan, haciendo públicas sus experiencias y comunicándose entre sí sus necesidades, éxitos, descubrimientos, fracasos, etc., una corriente de solidaridad y conveniencia pronto se establecería entre las Repúblicas Americanas en pro del beneficio mutuo y de un progreso, pródigo en bienestar.

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Y no hay duda que mayores beneficios habrían de alcanzarse si al frente de tan importantes dependencias pudieran estar, en un futuro relativamente próximo, jóvenes que hubiesen recibido la misma educación agrícola, que conocieran los tres idiomas (español, inglés y portugués) que se hablan en la América y que habiendo recibido su educación bajo las mismas tendencias prácticas, pudieran juntar a su acopio científico y a su sabia experiencia, un pleno conocimiento de las necesidades por remediar en su suelo nativo. A tan óptimas calidades hay que agregar la sin igual ventaja del compañerismo, que vinculando con los más fuertes e indisolubles lazos de la amistad adquirida en el colegio, a todos los que debieran estar al frente de las dependencias agrícolas de cada nación, sería una palanca poderosa para el intercambio agrícola, de las nacionalidades americanas.

Indudablemente es grande el desarrollo adquirido por las plantas cultivadas en la América, pero existe una deficiencia, que acaso sería el momento oportuno de contrarrestar. En el actual aislamiento agrícola de los países americanos, cada uno de ellos ha procurado defenderse de las plagas y enfermedades que atacan sus sembrados y aunque unos más que otros han podido librarse de tales azotes, es evidente que se obtendrían eficaces resultados, si la unión de todos los países del continente se pudiera hacer efectiva, dictando resoluciones generales de cumplimiento obligatorio para la destrucción de las plagas y para combatir las enfermedades de las plantas, evitando su contagio de un país a otro, o entre las plantaciones del mismo país.

Principalmente la plaga de la langosta por las grandes distancias que recorre, es una amenaza para las plantaciones de un extremo al otro de la América; y en vez de librarse de ella haciéndola pasar a casa del vecino, por un mal entendido egoísmo, mejor sería unificar los esfuerzos para destruirla en los lugares que se encuentra.

El espíritu altruista de la humanidad cada vez se evidencia de manera más desinteresada; y siguiendo el ejemplo dado por los hombres de buena voluntad de Estados Unidos, acudiendo con toda clase de recursos, a los lugares en que por una u otra causa la humanidad padece dolencias o privaciones, excogítense los medios de perseguir los peligros y enfermedades de las plantas uniendo todos los esfuerzos. Aunadas todas las energías de los centros directores de los pueblos de la América, en la prosecución de tan laudables fines, habríanse de recoger ventajas incalculables, que hoy por uno, mañana por otro, acercarían más y más a los habitantes del nuevo mundo, cimentando cada vez sobre más sólidas bases, la concordia y solidaridad americanas.

Como corolario de lo expuesto suscintamente en la anterior disquisición y fundándome en el carácter práctico que el Congreso Científico Pan-Americano tendrá, en beneficio de los pueblos de este continente, propongo las conclusiones siguientes para el Punto VI de la Sección III. Acaso parecerá compleja y difícil la realización de un convenio que abarcara los puntos que se proponen como conclusión de este trabajo.

La buena voluntad todo lo vence y la importancia que tendría en un cercano porvenir para la agricultura americana, el cumplimiento de una convención calcada en los o parecidos acuerdos que se indicarán es tal, que el patriotismo de los gobiernos americanos debe hacer todo esfuerzo que tienda a realizarla. Para aumentar la cordialidad entre los pueblos de América, hay que hacer que se conozcan, hay que fomentar su riqueza, hay que demostrarles que su bienestar lo tienen en casa y que la madre tierra del nuevo continente espera los explosivos, para romper la dureza y virginidad de sus subsuelos privilegiados y que el acero transformado en rejas de arado e instrumentos agrícolas, devuelva, mil por uno, el aureo grano echado al surco.

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¡Nuevo mundo, nuevos ideales! Mientras la vieja Europa se propone matar todo progreso, acabar con toda energía, echando unos sobre otros sus mejores hijos, nosotros los americanos a la sombra de la paz, trabajemos sinceros por el acercamiento americano, por el bienestar americano y por la cordialidad y concordia americanas; y siguiendo la senda por donde han ido, los pocos sabios que en el mundo han sido—que dijo el famoso poeta—hinquemos la rodilla en tierra, como lo hiciera el inmortal Colón, al pisar por vez primera el continente y agradeciendo a Dios los tesoros que nos guarda la privilegiada América, gastemos las energías de nuestra vida en el laboreo de las tierras, haciendo entrar hasta las más remotas localidades, los métodos modernos de cultivo de las plantas conocidas de productos valiosos, y procuremos arrancar los secretos que aún guarda la ávida naturaleza de nuestro suelo privilegiado, que hoy como ayer y mañana como hoy, espera el esfuerzo de nuestros brazos, para rendirnos sus indecibles veneros de riqueza, en medio de la tranquilidad y el bienestar.

Labor omnia vincit!

Manos a la obra!

CONCLUSIONES.

La celebración de un convenio entre las Repúblicas Americanas estableciendo para cada una de las partes contratantes la obligación de llevar a cabo los siguientes puntos:

1°. Verificar por medio de la Oficina de las Repúblicas Americanas de Wáshington un intercambio periódico de noticias acerca de los cultivos empleados en cada país para las plantas industriales conocidas; manera de utilizar debidamente sus productos; ensanche e iniciación de aquellos cuyo uso conviene generalizar; necesidades agrícolas que se presentan; escollos que hay que vencer, etc. El intercambio podría hacerse por publicaciones frecuentes emanadas de los Ministerios o Direcciones de Agricultura.

2°. Creación en todos aquellos países, donde no las haya, de Estaciones Experimentales que tengan por objeto:

(A) Dar a conocer en las diferentes localidades de cada nación los métodos más adelantados de cultivo de las plantas industriales y el uso de las maquinarias e instrumentos modernos, dando la preferencia a la manufactura americana, en igualdad de condiciones.

(B) Estudiar y propagar todas aquellas plantas oriundas de sus localidades, que puedan proporcionar cualquier producto útil.

(C) Ponerse en comunicación con todas las Estaciones similares de su país, para el canje de observaciones.

3°. Creación en algún lugar adecuado de los Estados Unidos de América, de un Instituto de Agricultura Hispano-Americano bajo la dependencia del Departamento de Agricultura de Wáshington, en donde deban darse los cursos que se estime oportuno, para la formación de peritos que adquieran un título especial, que los ponga en posibilidad, al regresar a sus respectivos países, de ponerse al frente de las Estaciones Experimentales. Cada país enviará un número determinado de alumnos, costeándoles la educación, y concluídos los estudios, quedarán con la obligación de regresar a su patria a estar al servicio de los Departamentos de Agricultura por un número prudencial de años.

4°. Unificación de todas las leyes y disposiciones para destruir plagas (langosta, chapulín, etc.) y combatir enfermedades de las plantas; adoptando un método general adecuado para contrarrestar dichos males y que contenga medidas obligatorias y profilácticas para destruirlos y prevenirlos.

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# EL MANGANESO EN LA CAPA ARABLE DEL URUGUAY.

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## INTRODUCCIÓN.

Uno de los temas que más ha preocupado a los agrónomos en estos últimos tiempos, es el que se relaciona con los abonos catalíticos, es decir, de elementos que con su presencia favorecen determinados fenómenos, que tienen por resultado, una mayor actividad en el organismo vegetal.

De los cuerpos simples, que componen el reducido grupo de elementos que obran por su presencia, es indudablemente el manganeso, el que en atención a su constante presencia en las tierras presenta los fenómenos más curiosos.

Estamos persuadidos, de que en un futuro no muy lejano, se despejará la incógnita que envuelve el mecanismo de los abonos citados, y se tendrán datos concretos y exactos sobre la importancia del manganeso en los vegetales; será entonces, cuando el presente trabajo tendrá su valor práctico verdadero, dado que indica la distribución en el territorio del Uruguay de las reservas de este metal acumuladas en la capa arable.

Hubiera sido ilustrativo establecer un parangón, entre las cifras obtenidas como término medio del porcentaje de manganeso en el Uruguay y el de otro Estado, pero a pesar del interés que tomamos, no nos fué posible conseguir datos que indiquen el tenor medio de este metal en la capa arable de otro país.

## LA PRESENCIA DEL MANGANESO EN LOS VEGETALES.

La naturaleza íntima de la célula vegetal está compuesta por elementos, que atendiendo a su presencia constante o accidental en las cenizas, han sido divididos en dos grupos, uno de ellos el más numeroso es el de las substancias que no son necesarias para la vida de las plantas, o dicho con más precisión a la mayoría de ellas; el otro grupo lo constituyen los elementos indispensables para el desarrollo completo del vegetal.

El manganeso hasta hace muy pocos años se le tenía en cuenta en química agrícola solamente de un modo muy relativo, figurando siempre entre los elementos raros y accidentales de los vegetales. Actualmente gracias al empleo de métodos de análisis de extrema exactitud, basados en la transformación de este metal en ácido permangánico, se ha tratado el asunto en su aspecto científico y ya lo hacen figurar algunos autores entre los cuerpos indispensables a las plantas, basados en su constante presencia en los residuos de la calcinación.

Nosotros hemos sometido al análisis vegetales de distintas especies y hemos encontrado en la mayoría de ellos manganeso: comprobamos su presencia en las hojas del peral, en una proporción muy débil, así como en las del naranjo, no obstante estar en cantidad relativamente elevada en las hojas de otros frutales como el duraznero y no haber obtenido reacción alguna en las de la vid americana y manzano.

El eucaliptus lo posee en una proporción muy vecina a la del duraznero. El álamo de Italia y el paraíso dieron reacción negativa y el ombú la dió débil.

Es en los frutos del pimiento donde hemos encontrado manganeso en mayor cantidad, negándonos reacción algunas plantas pseudo-alimenticias, como la canela y la yerba mate. Los clavos de olor tienen una proporción algo menor que al eucaliptus.

El café lo contiene en el mismo grado que el naranjo.

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En algunas graminácas hemos encontrado el manganeso en muy pequeñas cantidades como en el alpiste y en el maíz, no habiendo encontrado en el trigo a pesar de haber leído trabajos que hacen figurar a este metal en las cenizas del cereal nombrado.

Las hojas del tomate lo contienen en muy apreciable cantidad, la de porotos comunes no dieron reacción.

Se ha trabajado con diez gramos de sustancia secada al aire. A continuación se dan los resultados obtenidos, calculados en manganeso métalico, para mil gramos del producto sometido al análisis.

Trigo (Tritucum vulgare), negativa.
Naranjo (Citrus aurantium), 0.gr.0103.
Peral (Pyrus communis), vestigios.
Duraznero (Persica vulgaris), 0.gr.0612.
Vid Americana (Vitis solonis), negativa.
Eucaliptus (Eucaliptus globulus), 0.gr.0619.
Manzano (Malus communis), negativa.
Álamo de Italia (Populus italicus), negativa.
Ombú (Phytolacca dioica), 0.gr.0051.
Alpiste (Phalaris canariensis), 0.gr.0103.
Maíz (Zea mais), vestigios.
Paraíso (Melia azedarach), negativa.
Café (Coffea arabica), 0.gr.0103.
Porotos (Phaseolus vulgaris), negativa.
Tomates (Solanum lycopersicum), 0.gr.0541.
Pimiento (Piper nigrum), 0.gr.0954.
Canela (Cinnamomum zeylanicum), negativa.
Yerba mate (Ilex paraguariensis), negativa.
Clavo de Olor (Eugenia caryophylata), 0.gr.0464.

Los padres de la química moderna se han ocupado del manganeso en los vegetales con algún interés. Así Schelle en sus "Memorias de Química" en el Siglo XVII hacía notar que había encontrado poca cantidad en las cenizas del comino salvaje y más en las de la madera. Herapath ha señalado en 1849 la presencia del manganeso en las cenizas del rábano, de la remolacha y de la zanahoria. Después de él Richardson la ha indicado en las cenizas de la caña de azúcar Salm Hortsmar comprobó su presencia en las cenizas de la avena y le atribuyó una importancia especial, empleándolo en varios de sus medios artificiales de cultivo.

Liebig a propósito del tema que nos ocupa, decía lo siguiente: "El te y el café son notables por lo que ellos encierran de hierro y de manganeso; cuando se evapora a sequedad una solución límpida de te Pekas o Souchong y se incinera el residuo se obtienen cenizas frecuentemente coloreadas en verde por el manganato de potasio, y desprenden por consecuencia cloro en contacto con el ácido clorhídrico.

Sachs trató de substituir en la formación de la clorófila el hierro por el manganeso, sin éxito.

### LA INFLUENCIA DEL MANGANESO EN LA VEGETACIÓN.

El manganeso que existe en las plantas guarda relación con el que contiene la tierra de la cual éstas son parásitas y de la presencia de este metal en determinandas proporciones en el suelo, parece, según experiencia que citaremos, estar íntimamente ligada la nutrición y su consecuencia lógica palpable, el aumento de rendimiento en las cosechas.

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La influencia favorable del manganeso en la vegetación, la comprobó por primera vez Pichard, años después G. Bertrand y Themassin han hecho conocer los notables resultados que obtuvieron en cultivos extensivos, empleando el sulfato de manganeso como abono. El aumento de rendimiento conseguido por los experimentadores citados en cultivos de avena, llegó en la paja a un 18 por ciento y en los granos a 26 por ciento, sobre lo obtenido en parcelas testigos.

Muchos otros experimentadores han continuado ensayando las sales de manganeso en la vegetación; entre los trabajos más notables pueden citarse los de Loew y Sawa, los que llegaron a la conclusión de que el sulfato de manganeso produce una superabundancia de producción, siempre que la dosis empleada esté comprendida entre los límites de 0.002 por ciento y 0.02 por ciento, Excediéndose de este máximum las hojas se ponen cloróticas.

Nagoaka experimentó en cultivos de arroz, obteniendo resultados muy favorables en la cosecha de granos. En las mismas parcelas, en que este experimentador había abonado en una proporción de diez a cincuenta kilos de sesquioxido de manganeso por hectárea, hizo nuevas siembras al año siguiente, obteniendo sin agregar abono, en las parcelas que contenían a razón de 25 kilos por hectárea, un exceso de producción que alcanzó a un 17 por ciento.

Aso experimentó con el cloruro de manganeso comercial, obtenido como residuo de la fabricación del cloro, siguiendo el esquema trazado por el experimentador anteriormente citado y obtuvo resultados enteramente semejantes a los de este.

Experiencias muy interesantes ha efectuado Boullanger colocando todos los ensayos en idénticas condiciones y haciendo de este modo comparables los resultados. Este experimentador eliminaba por el cultivo en tiestos la influencia perturbadora de las variaciones atmosféricas y la no menos importante de la diferente composición de las tierras sobre las que se experimenta.

Boullanger empleó primeramente el cloruro de manganeso en cultivos de papas. Hizo dos series de experiencias, una de ellas sobre tierra arenosa pobre y la otra sobre tierra arcillosa rica, con los resultados que muestra el cuadro siguiente:

TIERRA SILICOSA POBRE.

| | Número de tubérculos. | Peso total en gramos. | Peso del más pequeño tubérculo. | Peso del más grande tubérculo. |
|---|---|---|---|---|
| 1° Sin abono y sin cloruro de manganeso | 8 | 438 | 5 | 127 |
| 2° Sin abono con cloruro de manganeso | 4 | 468 | 79 | 153 |
| 3° Abono completo sin cloruro de manganeso | 12 | 832 | 6 | 212 |
| 4° Abono completo con cloruro de manganeso | 9 | 1,115 | 32 | 295 |

TIERRA ARCILLOSA RICA.

| | | | | |
|---|---|---|---|---|
| 1° Sin abono y sin cloruro de manganeso | 10 | 682 | 2 | 184 |
| 2° Sin abono y con cloruro de manganeso | 9 | 908 | 10 | 220 |
| 3° Abono completo sin cloruro de manganeso | 17 | 892 | 3 | 195 |
| 4° Abono completo con cloruro de manganeso | 15 | 961 | 13 | 240 |

El examen de las cifras, dice el experimentador, conduce a resultados interesantes; se observa desde luego, que si el manganeso obra, tal vez por si mismo como abono, parece sobre todo obrar como excitante, permitiendo por un mecanismo hasta ahora desconocido una utilización mayor de los elementos fertilizantes del suelo. Si el suelo es pobre en elementos fertilizantes la influencia del manganeso resulta débil, ella se vuelve considerable si se agrega a este suelo

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los elementos fertilizantes que le faltan. Si el suelo es rico, el manganeso obra en seguida, puesto que la planta puede disponer de elementos abundantes; en presencia de fuertes dosis de abono hay siempre aumento de cosecha bajo la sección del manganeso, pero este aumento es proporcionalmente más débil pues hay evidentemente un límite de asimilación de la planta. Se observa también en los datos de los cuadros que los abonos de manganeso parecen disminuir el número de tubérculos recogidos y aumentar fuertemente su peso, que da como resultado que el peso de la cosecha sea finalmente mucho más elevado.

Las experiencias que se citan fueron repetidas durante varios años con el cloruro de manganeso y con otras sales de este metal obteniéndose en todas ellas resultados enteramente concordantes.

En distintos países se ha trabajado con objeto de despejar la incógnita del efecto del manganeso en la vegetación; los resultados fueron en la mayoría de las veces declarados por un exceso de producción. En muchos casos no se ha obtenido éxito con el empleo de las sales del manganeso, debido a haberse usado en dosis elevadas, lo que según lo han demostrado todas las experiencias, produce un efecto nulo y a menudo contrario al de excitabilidad que ejerce empleándolo en dosis mínimas.

No corresponde a la índole de este trabajo estudiar detalladamente el modo como actúa el manganeso en las plantas, pero si nos parece que cabe dentro de él, como complemento, la exposición de las teorías científicamente esbozadas sobre el papel fisiológico del manganeso, teorías, que si bien no aclaran el misterio en todas sus partes trazan los principios fundamentales, basadas en el conocimiento íntimo de los caracteres del metal y sus sales.

Al estimar la teoría del manganeso es conveniente recordar que de la función de los cuerpos simples de que está formado el vegetal no se sabe sino muy poco; así, por ejemplo, el silicio, que se encuentra en cantidad en muchas plantas, sobre todo en la familia de las gramináceas, parece que fuera indispensable para su vida, sin embargo se han cultivado estas plantas en medios artificiales privados de aquel elemento y las plantas se desarrollaron sin contratiempo alguno, lo que indica que pueden pasar sin él.

El cloro parece que tiene una acción decisiva sobre la formación del almidón y sobre la distribución de todos los hidrocarburos. Se ha observado que las papas cultivadas en suelos ricos en cloro son más pobre en almidón, que las cultivadas en suelos donde el tenor de este metaloide sea menor; se ha deducido de aquí, que cuando se siembran papas con el fin industrial de la explotación del almidón, es necesario evitar los suelos con mucho cloro y los abonos que contengan este elemento.

Se admite el potasio como favorecedor del desplazamiento de los hidrocarburos.

El calcio es indispensable para el desarrollo completo de la hoja. Los vegetales sin clorófila pueden, según afirma Palladini, pasarse sin él.

El magnesio parece desempeñar un papel muy importante en la formación de los albuminoides. El hierro es sin duda alguna uno de los elementos que interviene con más eficacia, en la formación de la clorófila.

El manganeso es muy vecino del hierro por sus caracteres, so distingue de éste porque es más oxidable y los compuestos superiores se forman mucho más fácilmente; por otra parte, los compuestos correspondientes del hierro y del manganeso se parecen mucho y son a menudo isomorfos.

Desde el punto de vista químico, el manganeso se caracteriza por una gran variedad de compuestos, él no forma menos de cinco óxidos de grado de oxidación diferente y tienen la curiosa propiedad sus óxidos de formar bases y ácidos; los más bajos dan origen a las primeras y los más elevados a los segundos.

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Mientras que los óxidos bajos se aproximan al magnesio, los altos en algunas reacciones son isomorfos con el titano, el aluminio y algunos metaloides, como el azufre y el cloro.

Teniendo presentes los caracteres del manganeso se puede aceptar sin dificultad alguna que una vez que atraviesa la membrana de las raicillas, sube con los otros metales en solución en la savia, debido a los fenómenos conocidos de capilaridad y evaporación y en su ascenso va oxidándose y llega a su máximo de oxidación al ponerse en contacto con el aire, en los estomas aeríferos de la epidermis foliai; allí sufre una especie de concentración y cede el oxígeno que había absorbido para el desarrollo y vida de los fermentos y producción de las complejas síntesis orgánicas de que es capaz el vegetal.

Una vez cedido el oxígeno está el manganeso en condiciones de oxidarse nuevamente; en todos estos fenómenos, según Bertrand, va el manganeso unido a pequeñas dosis de hierro, cuerpo que posee propiedades muy parecidas al manganeso en esta clase de fenómenos.

El manganeso en solución en la savia vendría a ejecutar en cierto modo una acción análoga a la que desempeña en la sangre la hemoglobina. Pero la acción eficaz del manganeso, no sólo es de purificar la savia, sino que le está reservado a este elemento otra función de defensa y protección, tan necesaria para hacer fácil la vida, cuanto lo es la otra para las elaboraciones orgánicas.

Siguiendo el recorrido de la savia y con ella el del manganeso al descender ésta se pone nuevamente en contacto del aire en las ramas y el tallo y concluye su recorrido, de nuevo oxigenada. Al llegar al extremo de las raíces cumple su misión purificadora, que es la de contribuir con el oxígeno necesario, para la destrucción de las toxinas, que se encuentran en el suelo; secreciones orgánicas francamente desfavorables para la vida de los vegetales.

### EL MANGANESO EN LA CAPA ARABLE DEL URUGUAY.

Las muestras de tierra que han servido de base para el presente trabajo, han sido tomadas de todos los departamentos de la república y siguiendo siempre, como lo demuestra el mapa adjunto, las líneas del ferrocarril. Se ha observado esta norma de conducta teniendo en cuenta lo estratégicamente, que para los fines que se persiguen en este trabajo, están trazados los ferrocarriles; además es una práctica muy generalizada siempre que se debe hacer referencia a una localidad, si este no es un pueblo muy importante que se le dé el nombre de la estación ferroviaria más próxima.

Las muestras tomadas pasan de 500, si bien, muchas no han sido analizadas directamente, sino el resultado de la mezcla de varias de la misma localidad.

Las tierras se tomaron en parajes próximos a las estaciones, algunas pocas en colonias agrícolas y alrededores de ciudades rurales. El peso de cada muestra era aproximadamente de 100 gramos cada una sacada con un trasplantador pequeño y a una profundidad no mayor de 10 centímetros.

Se trató de tomar siempre que fué posible, muestras de tierras que no hubieran sido entregadas al cultivo, para evitar así posibles sustracciones de la materia motivo de análisis. Las muestras a medida que se tomaban eran colocadas en bolsitas blancas de tela, en donde se indicaba el paraje de procedencia. Debemos hacer notar que todas las muestras de tierras que figuran en este trabajo fueron tomadas personalmente por el que suscribe. El método seguido en el presente estudio para la investigación del manganeso ha sido el de Hoppe-Seyler, modificado por Leclerc, indicado en el tratado de Análisis de las materias agrícolas, por L. Grandeau, del siguiente modo:

*Dosaje del manganeso en los suelos y en las cenizas.*—El método del dosaje del manganeso en los suelos y en las cenizas de los vegetales por las pesadas es



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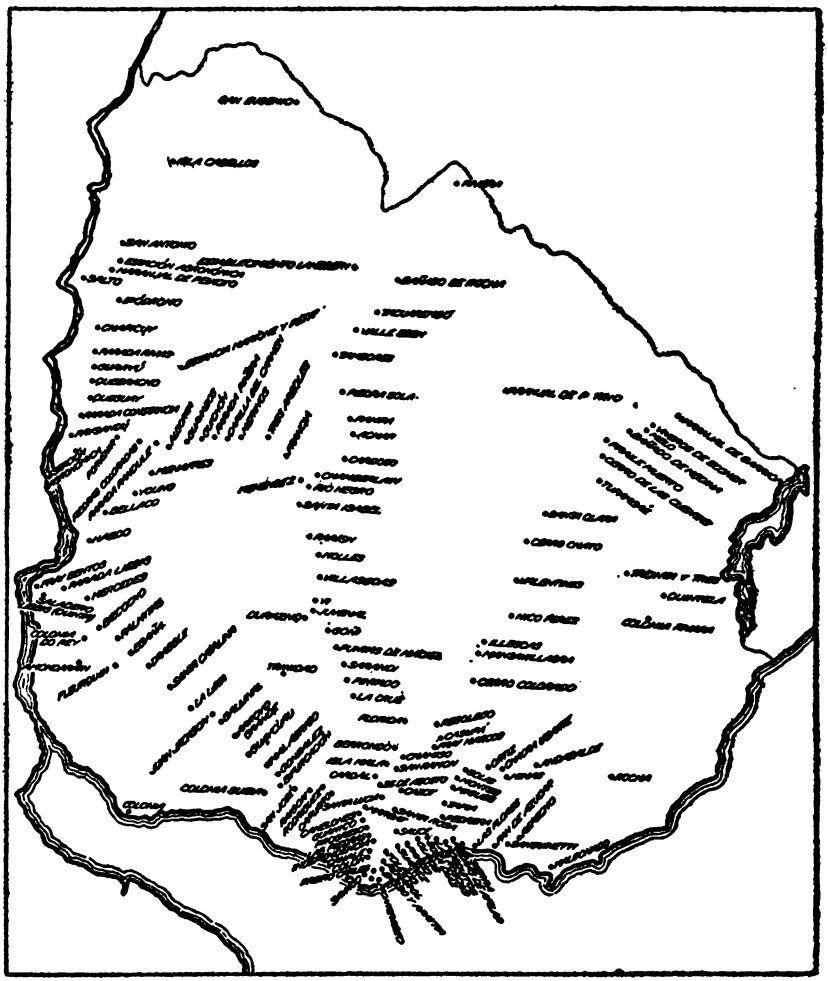
poco preciso, si no se opera sobre grandes cantidades de materias. El procedimiento por los licores titulados, inventado por M. Leclerc, une a la rapidez de ejecución la exactitud de las titulaciones. Este procedimiento consiste en transformar el manganeso de una solución nítrica en permanganato y en titular éste por medio de un licor apropiado. Esta transformación es muy fácil efectuarla por medio del minium, ya que el hierro y el aluminio, únicos cuerpos que podrían actuar sobre el permanganato, existen en estado de peróxido en el



MAPA QUE INDICA LOS LUGARES DE DONDE SE HAN SACADO MUESTRAS DE TIERRAS.

momento de la transformación. Se producirá esta reacción siempre que no existan huellas de cloro en las materias empleadas, pero antes de aplicar este método a un dosaje es conveniente conocer algunos detalles prácticos de la experiencia.

Si se opera con tierras, antes de atacarlas por el ácido nítrico es menester destruir en lo posible por calcinación las materias orgánicas, agregar ácido nítrico puro, llevarlo a la ebullición y evitar durante el ataque la evaporación

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por sequedad. Se correría el riesgo de fracasar en muchos análisis si no se guardara esta precaución pues es sabido que el nitrato de manganeso se descompone a 140 grados en $MnO^3$ que en esas condiciones es casi inatacable por el ácido nítrico. Cuando el ataque es completo, se filtra y se extiende el líquido hasta un volumen determinado. Una fracción de este volumen, aquélla en la cual se ha separado el cloro por el nitrato de plata, es llevada a la ebullición en una cápsula de porcelana. En ese momento se la retira del fuego y cuando la masa líquida ya no hierve, se le agrega un poco de minium, agitanto constantemente. Se desenvuelve una bella coloración violeta de permanganato de potasa, atenuada en parte por el óxido pulga de plomo que se ha formado y se deposita, coloración cuya intensidad está en relación con la cantidad más o menos grande de manganeso. Si el minium no fuera atacado, lo que sucede cuando el licor es débilmente ácido, se agregará un poco de ácido nítrico para favorecer la reacción. Se deja depositar durante algunos minutos y se filtra sobre amianto bien exento de cloro. Entonces se procede a la titulación del licor filtrado. En ese momento el licor encierra un pequeño exceso de ácido nítrico, permanganato de potasa, nitrato de plomo, sales de hierro, de aluminio, magnesio, calcio, sodio y potasio. El nitrato de plomo que no permite hacer la titulación con el sulfato doble de hierro y de amoniaco, a causa del precipitado de sulfato de plomo, que impide sorprender el momento en que la descomposición del permanganato es completa, y como el ácido oxálico da también carbonato de plomo, a no ser que el licor encierre un exceso de ácido nítrico y como exige, por otra parte una temperatura muy elevada, el Sr. Leclerc emplea otro reductor: el nitrato mercurioso que permite notar claramente el pasaje de la coloración violeta del permanganato a una coloración diferente. En presencia de un oxidante enérgico como el permanganato se transforma en nitrato mercúrico, y el fin de la descomposición se señala por el pasaje rápido de la coloración rosada de la solución de permanganato al amarillo verdoso, cuando hay mucho manganeso, o a una solución incolora cuando el manganeso existe en débil cantidad. Con este licor ningún precipitado se forma inmediatamente, a menos que la solución no encierre mucho manganeso. La titulación es más fácil cuando el licor es ácido, el precipitado de sesquióxido de manganeso que se forma en este caso perjudicaría el viraje. Pero en la mayor parte de los casos no se manifiesta durante la titulación ningún precipitado cuando la solución encierra ácido nítrico libre en cantidad suficiente.

NÓMINA DE LOS LUGARES DE DONDE SE HA TOMADO MUESTRAS PARA ANÁLISIS.

Montevideo: Quinta de R. Freire, Colón; Canals, Peñarol; Carles, Sayago; Basso y Apattia, Colón; Cervetti, Paso de Arena; Magnano, Peñarol.

Canelones: Martins, Independencia; Estación (alrededores) Las Piedras, Progreso, Juanicó, Margat, Santa Lucía, 25 de Agosto, Cardal, Sauce, Pedrera, Santa Rosa, Cazot, Castellanos, Toledo, Pando, Olmos, Sosa Diaz, Las Toscas, Mosquitos, Piedras de Afilar, Migues; Ciudad Canelones, San Ramón; Estación Cortijo Vidella.

Florida: Estación (alrededores) Isla Mala, Berrondo, La Cruz, Pintado, Sarandi, Puntas de Macial, Goñi, Fray Marcos, Chamizo, Casupa, Reboledo, Cerro-Colorado, Manzavillagra; Ciudad Exposición-Feria.

San José: Ciudad Capurro, Rodríguez, Raigón, San José; Estación (alrededores) Bifurcación, Gonzalez, Mal Abrigo, Guaicurú.

Flores: Estación (alrededores) Arroyo Grande; Ciudad Trinidad.

Colonia: Ciudad Colonia, Colonia Suiza; Estancia Gallinal, Juan Jackson.

Soriano: Estación (alrededores) Santa Catalina, Drabble, Egaña, Palmitas,

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Bizcicho; Ciudad Mercedes; Colonia De Rey, Palmitas; Estancia Amondaray, Palmitas, Estancia Fleurquin, Palmitas, La Lata.

Maldonado: Estación (alrededores) La Sierra, Las Flores, Pan de Azúcar. Repecho; Estancia Sanguinetti, Repecho; Ciudad (alrededores) Maldonado.

Rocha: Ciudad (alrededores) Rocha.

Minas: Estación (alrededores) Tapia, Solís, Ortiz, Minas; Chacra A. Ugarte, Minas; Chacra Andabalde, Minas.

Treinta y Tres: Ciudad (alrededores) Treinta y Tres; Estancia Quintela, Colonia Rivera, Treinta y Tres; Estación (alrededores) Cerro-Chato, Valentines, Santa Clara.

Cerro-Largo: Estación (alrededores) Tupambae, Cerro de las Cuentas, Fraile Muerto, Melo; Naranjal de Garrion, Melo; Naranjal de P. Trio, Melo; Víveros de A. Eccher, Melo.

Durazno: Campos de Juvenal, Durazno; Estación (alrededores) Villas Boas, Molles, Parish, Durazno.

Tacuarembó: Estación (alrededores) Chamberlain; Cardozo, Achar, Pampa, Piedra Sola, Tambores, Valle Edén; Ciudad (alrededores) Tacuarembó; Establecimiento Lanzzeri, Bañados de Rocha; Estación (alrededores) Bañados de Rocha, Illescas, Medina.

Salto: Ciudad (alrededores) Salto; Estación Agronómica, Salto; Naranjales de Peixoto, Salto; Hipodromo (alrededores), Salto.

Artigas: San Eugenio (alrededores) Artigas; Estación (alrededores) Isla-Cabellos.

Rivera: Ciudad (alrededores) Rivera.

Rio Negro: Ciudad (alrededores) Rio Negro, Fray Bentos; Estación (alrededores) Francia, Menendez, Parada Salsipuedes, Menafres, Young, Bellaco, Haedo, Parada Liebig; Santa Isabel, Rio Negro; Saladero Liebig (Quinta) Fray-Bentos; Camino a Mercedes, Fray-Bentos.

Paysandú: Estación (alrededores) Tres Árboles, Merinos, Capilla del Carmen, Parda Piñera, Guichon, Guayabos, Álgorta, Parada Pandule, Piedras Coloradas, Porvenir, Quegay, Quebracho, Guaviyú, Parada Rivas, Chapicuy; Estación Agronómica, Paysandú; Ciudad Paysandú; Estancia Marione y Petit, Piedras Coloradas.

Para facilitar la interpretación de los resultados, se han ordenado las tierras por Departamentos, indicando en cada uno de ellos los lugares de donde se han tomado muestras y el tenor máximo y mínimo calculado en manganeso métalico por kilo de tierra sacada al aire.

DEPARTAMENTO DE MONTEVIDEO.

| Muestras analizadas, 6. | Gramos. |
|---|---|
| Promedio | 0.1589 |
| Cantidad mayor encontrada | .2322 |
| Cantidad menor encontrada | .0258 |

*Muestras analizadas y cantidad de manganeso.*

| | |
|---|---|
| Quinta de Román Freire | .1806 |
| Quinta de Charles (Sayago) | .2198 |
| Quinta de Canale (Peñarol) | .2141 |
| Quinta de Basso y Apatía (Colón) | .0258 |
| Quinta de Magnano (Peñarol) | .2322 |
| Quinta de Cervetti (Paso de la Arena) | .0815 |

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*Canelones.*

| Número de muestras analizadas, 24. | Gramos. |
|---|---|
| Promedio de los análisis | .0957 |
| Cantidad mayor encontrada en el Departamento | .1702 |
| Cantidad menor encontrada en el Departamento | .0111 |

*Muestras analizadas.*

| Alrededores de la Estación: | |
|---|---|
| Las Piedras | .0941 |
| Progreso | .0712 |
| Juanicó | .1016 |
| Margat | .0456 |
| Canelones | .0649 |
| Santa Lucía | .1212 |
| 25 de Agosto | .1625 |
| Sauce | .0846 |
| Pedrera | .1082 |
| Santa Rosa | .1341 |
| Cazot | .1573 |
| Castellanos | .1522 |
| San Ramón | .1490 |
| Toledo | .0661 |
| Suárez | .0385 |
| Pando | .0335 |
| Olmos | .0319 |
| Sosa Díaz | .1702 |
| Las Toscas | .0674 |
| Mosquitos | .0741 |
| Piedras de Afilar | .1242 |
| Migues | .1620 |
| Cortijo Vidiella (Toledo) | .0111 |
| Quinta Martins (Independencia) | .0111 |

DEPARTAMENTO DE FLORIDA.

| Número de muestras analizadas, 17. | |
|---|---|
| Promedio de los análisis | .1785 |
| Cantidad mayor encontrada en el Departamento | .3818 |
| Cantidad menor encontrada en el Departamento | .0097 |

*Muestras analizadas.*

| Alrededores de la Estación: | |
|---|---|
| Illescas | .1782 |
| Fray Marcos | .1806 |
| Chamizo | .2064 |
| Casupa | .2270 |
| Reboledo | .1883 |
| Cerro-colorado | .1651 |
| Manzavillagra | .1315 |
| Cardal | .3818 |
| Isla Mala | .0496 |
| Berrondo | .1496 |

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| Alrededores de la Estación—Continued. | Gramos. |
|---|---|
| La Cruz | .1960 |
| Pintado | .1909 |
| Sarandí | .2270 |
| Puntas de Maciel | .3408 |
| Goñi | .0883 |
| Florida | .1236 |
| Exposición Feria | .0097 |

DEPARTAMENTO DE MALDONADO.

Número de muestras analizadas, 6.

| | |
|---|---|
| Promedio de los análisis | .0656 |
| Cantidad mayor encontrada | .1634 |
| Cantidad menor encontrada | .0178 |

*Muestras analizadas.*

| | |
|---|---|
| Alrededores de la Estación: | |
| La Sierra | .1634 |
| Las Flores | .0938 |
| Pan de Azúcar | .0386 |
| Repecho | .0417 |
| Alrededores de la Ciudad | .0178 |
| Estancia de Sanguinetti | .0387 |

DEPARTAMENTO DE MINAS.

Número de muestras analizadas, 8.

| | |
|---|---|
| Promedio de los análisis | .1217 |
| Cantidad mayor encontrada en el Departamento | .2896 |
| Cantidad menor encontrada en el Departamento | .0194 |

*Muestras analizadas.*

| | |
|---|---|
| Alrededores de la Estación: | |
| Nico Pérez | .0295 |
| Tapia | .0194 |
| Montes | .0851 |
| Solis | .1806 |
| Ortiz | .2896 |
| Minas | .1370 |
| Chacra de Ugarte | .1290 |
| Chacra de Andabalde | .1032 |

DEPARTAMENTO DE DURAZNO.

Número de muestras analizadas, 5.

| | |
|---|---|
| Promedio de los análisis | .1600 |
| Cantidad mayor encontrada en el Departamento | .2787 |
| Cantidad menor encontrada en el Departamento | .0975 |

*Muestras anadizadas.*

| | |
|---|---|
| Ciudad (alrededores) Durazno | .0975 |
| Campos de Juvinal | .1857 |

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| Estación (alrededores): | Gramos. |
|---|---|
| Parish | .1109 |
| Villasboas | .2787 |
| Molles | .1274 |

DEPARTAMENTO DE TACUAREMBÓ.

| | |
|---|---|
| Número de muestras analizadas, 10. | |
| Promedio de los análisis | .2986 |
| Cantidad mayor encontrada en el Departamento | .7504 |
| Cantidad menor encontrada en el Departamento | .0322 |

*Muestras analizadas.*

| | |
|---|---|
| Ciudad (alrededores) San Fructuoso | .0239 |
| Establecimiento Lanzzeri | .7504 |
| Estación (alrededores): | |
| Chamberlain | .5985 |
| Cardoso | .1288 |
| Achar | .0147 |
| Pampa | .1840 |
| Piedra Sola | .5882 |
| Tambores | .0322 |
| Valle Edén | .1312 |
| Bañados de Rocha | .5841 |

DEPARTAMENTO DE SAN JOSÉ.

| | |
|---|---|
| Número de muestras analizadas, 8. | |
| Promedio de los análisis | .1599 |
| Cantidad mayor encontrada en el Departamento | .1986 |
| Cantidad menor encontrada en el Departamento | .1083 |

*Muestras analizadas.*

| | |
|---|---|
| Alrededores: | |
| Ciudad San José | .1584 |
| Estación— | |
| Capurro | .1419 |
| Rodríguez | .1522 |
| Raigón | .1573 |
| Bifurcación | .1083 |
| González | .1831 |
| Mal Abrigo | .1834 |
| Guaycurú | .1986 |

DEPARTAMENTO DE FLORES.

| | |
|---|---|
| Número de muestras analizadas, 2. | |
| Promedio de los análisis | .2255 |
| Cantidad mayor encontrada en el Departamento | .2318 |
| Cantidad menor encontrada en el Departamento | .2193 |

*Muestras analizadas.*

| | |
|---|---|
| Alrededores: | |
| Ciudad Trinidad | .2318 |
| Estación Arroyo Grande | .2198 |

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DEPARTAMENTO DE COLONIA.

| Número de muestras analizadas, 8. | Gramos. |
|---|---|
| Promedio de los análisis | .0902 |
| Cantidad mayor encontrada en el Departamento | .1413 |
| Cantidad menor encontrada en el Departamento | .0902 |

*Muestras analizadas.*

| | |
|---|---|
| Ciudad (alrededores) Colonia | .0392 |
| Pueblo (alrededores) Colonia Suiza | .1413 |
| Estancia Gallinal | .0903 |

DEPARTAMENTO DE SORIANO.

| Número de nuestras analizadas, 10. | |
|---|---|
| Promedio de los análisis | .1859 |
| Cantidad mayor encontrada en el Departamento | .3379 |
| Cantidad menor encontrada en el Departamento | .0516 |

*Muestras analizadas.*

| | |
|---|---|
| Colonia Dorey | .1186 |
| Estancia: | |
| Amondaraín | .1341 |
| Fleurquín | .1651 |
| Ciudad (alrededores) Mercedes | .0516 |
| Estación (alrededores): | |
| La Lata | .2218 |
| Santa Catalina | .2863 |
| Drabble | .1806 |
| Egaña | .1212 |
| Palmitas | .3379 |
| Bizcocho | .2425 |

DEPARTAMENTO DE ARTIGAS.

| Número de muestras analizadas, 2. | |
|---|---|
| Promedio de los análisis | .1743 |
| Cantidad mayor encontrada en el Departamento | .2064 |
| Cantidad menor encontrada en el Departamento | .1423 |

*Muestras analizadas.*

| | |
|---|---|
| Ciudad (alrededores) San Eugenio | .2064 |
| Estación (alrededores) Islas Cabellos | .1423 |

DEPARTAMENTO DE TREINTA Y TRES.

| Número de muestras analizadas, 6. | |
|---|---|
| Promedio de los análisis | .2432 |
| Cantidad mayor encontrada en el Departamento | .3766 |
| Cantidad menor encontrada en el Departamento | .1393 |

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*Muestras analizadas.*

| | Gramos. |
|---|---|
| Ciudad (alrededores) Treinta y tres | .2941 |
| Estación (alrededores): | |
| Cerro Chato | .1444 |
| Valentines | .1393 |
| Santa Clara | .2822 |
| Estancia Quintela | .3766 |
| Colonia Rivara | .2729 |

DEPARTAMENTO DE CERRO LARGO.

Número de muestras analizadas, 8.

| | |
|---|---|
| Promedio de los análisis | .1208 |
| Cantidad mayor encontrada en el Departamento | .2502 |
| Cantidad menor encontrada en el Departamento | .0129 |

*Muestras analizadas.*

| | |
|---|---|
| Naranjal de: | |
| Garrión | .1315 |
| Pérez Trío | .6045 |
| Víveros de A. Eccher | .1831 |
| Ciudad (alrededores) Melo | .1130 |
| Estación (alrededores): | |
| Tupambaé | .0824 |
| Cerro de las Cuentas | .2502 |
| Fraile Muerto | .1290 |
| Bañado de Medina | .0129 |

DEPARTAMENTO DE SALTO.

Número de muestras analizadas, 4.

| | |
|---|---|
| Promedio de los análisis | .1198 |
| Cantidad mayor encontrada en el Departamento | .1573 |
| Cantidad menor encontrada en el Departamento | .0903 |

*Muestras analizadas.*

| | |
|---|---|
| Ciudad (alrededores) Salto | .1104 |
| Estación Agronómica | .0903 |
| Naranjales de Peixoto | .1212 |
| Hipódromo (alrededores) | .1573 |

DEPARTAMENTO DE RIVERA.

Número de muestras analizadas, 1.

*Muestras analizadas.*

| | |
|---|---|
| Rivera (alrededores de la ciudad) | .3147 |

DEPARTAMENTO DE RÍO NEGRO.

Número de muestras analizadas, 18.

| | |
|---|---|
| Promedio de los análisis | .1322 |
| Cantidad mayor encontrada en el Departamento | .2822 |
| Cantidad menor encontrada en el Departamento | .0252 |

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*Muestras analizadas.*

| | Gramos. |
|---|---|
| Ciudad (alrededores) Fray Bentos | .1496 |
| Pueblo (alrededores) Santa Isabel | .1398 |
| Quinta Saladero Liebig | .1554 |
| Camino a Mercedes | .1651 |
| Estación (alrededores): | |
| Río Negro | .1342 |
| Menéndez | .0252 |
| Francia | .2064 |
| Parada Salsipuedes | .0316 |
| Menafres | .1212 |
| Young | .1806 |
| Bellaco | .2322 |
| Haedo | .0645 |
| Parada Liebig | .1135 |

DEPARTAMENTO DE PAYSANDÚ.

Número de muestras analizadas, 19.

| | |
|---|---|
| Promedio de los análisis | .0841 |
| Cantidad mayor encontrada en el Departamento | .2883 |
| Cantidad menor encontrada en el Departamento | .0067 |

*Muestras analizadas.*

| | |
|---|---|
| Ciudad (alrededores) Paysandú | .0482 |
| Estación Agronómica | .0516 |
| Estancia Marione y Petit | .0527 |
| Estación (alrededores): | |
| Tres Árboles | .2883 |
| Merinos | .1186 |
| Capilla del Carmen | .0276 |
| Parada Piñera | .0470 |
| Guichon | .0670 |
| Guayabos | .1290 |
| Algorta | .1290 |
| Parada Pandule | .1130 |
| Porvenir | .1032 |
| Piedras Coloradas | .0662 |
| Parada Constancia | .0172 |
| Queguay | .0067 |
| Quebracho | .0541 |
| Guaviyú | .1135 |
| Parada Rivas | .1109 |
| Chapicuy | .0541 |

DEPARTAMENTO DE ROCHA.

Muestras analizadas, 1.

| | |
|---|---|
| Alrededores de la ciudad | .1444 |

Del examen de los resultados que preceden se deduce que la tonalidad del manganeso en las tierras de un mismo Departamento es muy saviable, así por ejemplo el Departamento de Tacuarembó que da como término medio de sus análisis casi tres decígramos de manganeso metálico por kilo de tierra

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y acusa un máximo de siete decígramos y medio en el Establecimiento de Lanzzeri, próximo a la Estación Bañados de Rocha da en esta Estación medio gramo, siendo la capa arable de la misma constitución física que la del Establecimiento nombrado y acusan los análisis tan sólo dos centígramos en la Ciudad de San Fructuoso, capital del Departamento, a poca distancia, como se puede observar en el mapa adjunto de Bañados de Rocha; y tres centígramos en la Estación Tambores. El Departamento de Florida muestra con su máximo de 0 gr. 3818 y su mínimum de 0 gr. 0097 la poca constancia de guarismos de valor en el lugar que ocupan los decígramos y hasta los centígramos. San José nos presenta en sus ocho análisis una regularidad muy marcada, pasando de la mayor cantidad a la menor con solo diferencia en la segunda cifra decimal. Los Departamentos del Sur, Montevideo, Canelones y San José tienen el manganeso repartido con relativa regularidad, no sucediendo lo mismo con los del Este. En todos los análisis de tierras efectuados, no se comprueba uno solo que no acuse manganeso y la mayor o menor cantidad de este metal guarda cierta relación con el color de la tierra; así ninguna tierra negra humífera nos ha dado un porcentaje muy elevado y todas las tierras rojizas de composición media contenían manganeso en cantidades notables. La tierra que dió cifra más alta entre todos los análisis es de una coloración francamente rojiza, que denuncia la presencia de sales de hierro; esta tierra es de un pequeño valle formado por el arrastre de las lluvias, donde se cultivan con éxito varios frutales. Como dato importante, consignaremos que el vino que se elabora en este lugar produce 14 grados con siete de alcohol, que es la graduación más elevada que conocemos en el país. La cantidad menor de manganeso encontrada corresponde a una tierra pobre de pastoreo, en los alrededores de la Estación Queguay.

### CONCLUSIONES.

Los datos consignados en el presente trabajo nos llevan á las siguientes conclusiones:

1. Que en todas las tierras arables del Uruguay analizadas existe manganeso.
2. Que el promedio de manganeso que contienen las tierras arables del Uruguay es de 0 gr. 1617, calculado en manganeso metálico y por kilo de tierra secada al aire.
3. Que la cantidad mayor de manganeso encontrada en los análisis practicados en tierras arables es de 0 gr. 7504, calculado en manganeso metálico y por kilo de tierra secada al aire.
4. Que la cantidad menor de manganeso encontrada en los análisis practicados en tierras arables es de 0 gr. 0067, calculado en manganeso metálico y por kilo de tierra secada al aire.
5. Que el Departamento a que corresponde la proporción más elevada de manganeso en su capa arable es el de Tacuarembó.
6. Que el Departamento a que corresponde la proporción menos elevada de manganeso en su capa arable es el de Maldonado.
7. Que las tierras rojizas contienen mayor proporción de manganeso que las tierras negras.

The CHAIRMAN. The next paper will be on "The prevention and eradication of destructive animal diseases and the effect upon agriculture and the meat supply," by A. R. Ward, of the United States Bureau of Animal Industry.

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## THE PREVENTION AND ERADICATION OF DESTRUCTIVE ANIMAL DISEASES AND THE EFFECT UPON AGRICULTURE AND THE MEAT SUPPLY.

By ARCHIBALD R. WARD,

*Bureau of Animal Industry, Department of Agriculture.*

Facts drawn from a variety of sources indicate that during recent years the domestic meat supply, more particularly beef, has been declining. Among the significant facts justifying this conclusion are figures showing the decline of exportation of live cattle and dressed beef as contrasted with the beginning of importation of meat and meat food products. It is also known that the number of beef cattle in the country has been decreasing,[1] and this fact is further reflected in the decline of number of cattle and calves slaughtered under the inspection of the Federal meat inspection service. Further confirmatory evidence is furnished by the decline of the per capita consumption of meat in the United States.

Such being the general meat situation, let us investigate the extent to which animal diseases are responsible for conditions and how far improved methods of handling animal diseases may alleviate matters.

The Bureau of Animal Industry maintains a meat-inspection system in all abattoirs handling cattle, calves, sheep, goats, or swine, the meat from which is destined in whole or in part for interstate or foreign shipment. The conditions of the packing-house system of meat handling are such that about 60 per cent of the meat from these classes of animals consumed in the United States is slaughtered under Federal inspection. The determination of condition of animals as regards disease is made by thorough, scrutinizing examinations of live animals by veterinary inspectors, before slaughter, and of the carcasses during the dressing of the meat. The statistics as to prevalence of animal disease gathered in connection with the veterinary inspection furnish a most reliable index of the importance of the diseases of the chief meat-producing animals of the United States. Consideration of the extent of losses through the condemnation of whole carcasses or parts on account of disease will be taken up first, on this account only, for the loss by disease from this source is greatly overshadowed by that caused by other factors.

Data showing the magnitude of the Federal meat-inspection system appear in the following table. The designation "part" as employed in the table refers to the usual sections, cuts, or parts of the dressed carcass commonly known in the trade, such as sides, quarters, shoulders, hams, backs, bellies, and heads, including the tongue.

*Total kill and condemnations for all causes at slaughter, fiscal year ending June 30, 1914.*

| Kinds of animals. | Total killed. | Condemnations. | | |
|---|---|---|---|---|
| | | Whole.[2] | Part. | Per cent condemned.[3] |
| Cattle | 6,794,117 | 54,417 | 138,085 | 2.86 |
| Calves | 1,814,904 | 6,733 | 1,234 | .44 |
| Swine | 33,289,705 | 352,921 | 423,275 | 2.33 |
| Sheep | 14,958,834 | 21,402 | 1,564 | .15 |
| Goats | 121,827 | 776 | 8 | .64 |
| All animals[4] | 56,909,387 | 436,249 | 563,166 | 1.76 |

[1] Statistics available recently indicate that a perceptible increase in the number of cattle in the United States occurred in 1915 and again in 1916.

[2] Includes carcasses passed for rendering into lard or tallow as well as those condemned outright.

[3] Includes both whole and parts; that is, the percentage given is of all carcasses the meat of which has been condemned in whole or in part.

[4] During the fiscal year ending June 30, 1915, 58,022,884 animals were slaughtered under Federal inspection. The increase of numbers of animals slaughtered over the figure for the preceding year is due largely to the fact that 2,629,586 more swine were slaughtered during the latter period.

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The diseases and conditions for which condemnations are made are classified under 42 groups, which are considered either dangerous or abhorrent to man when occurring in a meat-food product. The majority of these diseases are rare and constitute insignificant factors in condemnations.

During the fiscal year ending June 30, 1914, tuberculosis in cattle caused the condemnation of 29,738 carcasses, which constitutes 61 per cent of condemnations for all causes.[1] Parts condemned for the same disease in cattle amounted to 44,975, which constituted 32 per cent of parts of cattle condemned for all causes.

In addition to the figures regarding the condemnations of carcasses and parts, there should be considered the carcasses that were "retained" for tuberculosis in the parlance of the abattoir. During the year in question 143,699 beef carcasses, or 2.14 per cent of the whole kill, were retained for more detailed examination because of the discovery of some tubercular infection. This figure then represents the percentage of animals with tuberculosis in some degree that were slaughtered under Federal inspection. Deducting from the total number of animals so infected those condemned in whole, 29,738, and constituting 20 per cent of those diseased, we have remaining 123,961 carcasses infected to a moderate degree and eventually passed for food. Some of these were passed after rejecting "parts," and the remainder were passed after slight trimming. Tuberculosis in even this class of carcasses involves loss through the rejection of portions too small to be classed as a "part" in its technical meaning. There is additional cost in handling and trimming. Removal of foci of disease causes loss of tissue otherwise useful and of closely contiguous sound tissue. Further loss is caused by diversion of the product to a less profitable class. For instance, fat would be passed for inedible grease instead of tallow or lard. Paunches and intestines would go into the offal tank instead of being respectively converted into the edible products tripe and sausage casings. Hearts and livers likewise are converted into products less valuable than when used for human food.

In swine, too, the disease is a most important factor. There were condemned 48,252 carcasses, which constitutes 23 per cent of condemnation of carcasses of swine for all causes.[2] Of parts, 407,151 were condemned, which constitutes 96 per cent of all parts condemned. However, the fact that 2,200,995 carcasses, or 6.61 per cent of the total kill, were retained for tuberculosis reveals the fact of the greater prevalence of tuberculosis in swine than in cattle. Deducting from this total the number condemned in whole, amounting to 2 per cent of those found diseased, we have a residue of 2,152,743 slightly diseased animals. The low percentage of diseased hogs that are condemned as compared with cattle is because hogs are marketed while young, and consequently the disease does not have time to develop to the same extent as in cattle.

Hog cholera stands foremost among diseases causing condemnation at the abattoir. There were condemned for this disease 116,107 carcasses, or 56 per cent of all carcasses condemned. As it is a septicemic disease, the whole carcass is always condemned. In point of prevalence at the abattoir it is much below tuberculosis, as only 0.85 per cent of the whole kill showed the disease. The two diseases, hog cholera and tuberculosis, were responsible for the condemnation of 80 per cent of all hog carcasses condemned.

[1] During 1915, 32,644 beef carcasses were condemned for tuberculosis, which number represents 62 per cent of the total condemnations of beef carcasses for all causes.

[2] During the fiscal year ending June 30, 1915, 66,023 swine carcasses were condemned for tuberculosis. This figure represents 30 per cent of condemnations of swine carcasses for all causes.

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The estimation of the money value of the losses incurred by the condemnation of carcasses for these two diseases would be a complicated matter, involving the determination of an average value of the carcass at the moment of slaughter. Even more difficult would be the determination of a value for the average "part." The question of salvage value of carcasses and parts further complicates such an estimation. The task will be left for the statistician, and the point will be passed over with the observation that the losses from condemnation amount to millions of dollars a year.

The true importance of the veterinary meat-inspection statistics lies in the value of the figures as an index of animal-disease conditions in the country. However, it would not be safe to estimate the amount of tuberculosis in the country at large on the basis of that found in the 60 per cent of meat slaughtered under Federal inspection. It is a well-known fact that when tuberculosis is suspected in cattle, such as old dairy cows, they are slaughtered in abattoirs not subject to Federal inspection. Thus, tuberculosis is much more prevalent in cattle slaughtered than the figures would indicate.

The significant fact shown by the meat-inspection statistics is that the greatest losses are from the two diseases that have been most surely demonstrated to be preventable and controllable.

Tuberculosis, as shown by the slaughter statistics, is seen to be a significant factor in diminishing food supply, but this evidence falls far short of giving a proper idea of the importance of the disease. The direct and indirect losses due to its existence among dairy cattle is hardly suggested by the foregoing figures.

It is estimated that there were 21,262,000 milch cows on farms in the United States on January 1, 1915, valued at $1,176,338,000. The annual production of butter, condensed milk, and cheese has an approximate value of $600,000,000. In addition to this should be considered the estimated production of 7,462,000,000 gallons of milk, according to the 1909 census, a portion of which is consumed directly as market milk and is not absorbed by dairy manufacture.

The amount of tuberculosis in dairy animals as shown by the tuberculin test in widely separated localities is high. Melvin has summarized reports on tuberculin tests made by Federal, State, and other officers with tuberculin prepared in the Bureau of Animal Industry during a period of 15 years. Of 400,000 cattle tested, 9.25 per cent reacted. It was concluded that about 10 per cent of milch cows and 1 per cent of other cattle were affected. Other figures, less representative of the country as a whole, have revealed more alarming conditions in certain States. Moore reports 35 per cent reacting in New York State, the data being obtained from reports upon the use of tuberculin sent out by the New York State Veterinary College. Other figures supplied by the New York State Department of Agriculture showed 21 per cent reacting. The present writer found that of 1,022 dairy cattle in the San Francisco Bay region 31 per cent reacted. The disease may assume serious proportions among range cattle, as in a case reported by Baker and the writer, in which 38 per cent of California range cows showed infection.

The devastation wrought by tuberculosis in dairy cattle must be observed to be fully appreciated. It is accomplished chiefly by shortening the productive life of the cow by death, or by her sale at a sacrifice for slaughter sooner than would be necessary in the case of a healthy animal. Dairymen with startling frequency are weeding out cows rendered prematurely useless on account of tuberculosis alone, and frequently the cause is not recognized by the owner. The increase of cost of feeding a sick herd and the diminished return occasioned thereby need but to be mentioned.

The possibility of the eradication of bovine tuberculosis by the elimination from herds of animals found to be affected, as shown by the tuberculin test, or

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by physical examination, together with the application of appropriate sanitary measures, has been demonstrated in numerous herds.

Like the disease in cattle, the general facts regarding the dissemination of the disease among hogs are known, and economies may be effected by applying well-known methods.

Tuberculosis in fowls assumes the rank of an important disease on the Pacific coast and elsewhere. An intradermal tuberculin test for the detection of the disease exists. Further, the short life of fowls is a favorable circumstance in making possible its extinction in an establishment by eliminating diseased fowls and breeding young stock kept from contact with infection.

Of loss from diseases on the farms, those from hog diseases have been most carefully collected and strikingly presented for consideration. Disease has ravaged the hog-raising centers in the corn belt in waves of intensity about 10 years apart. One great outbreak reached the maximum in 1886 and 1887, with a loss of 134 hogs per 1,000 head. In 1896 and 1897 losses again rose to 144 per 1,000 head. At present a third epizootic is in progress, with a loss of 119 per 1,000 head in 1914. These figures are to be compared with the death rate of 54.9 per 1,000 determined from the average yearly loss for the 10 preceding years. It is estimated that hog cholera constitutes 90 per cent of the causes of hog mortality as enumerated. Applying the percentage of loss determined for 1914 to the total number of hogs on farms, we find a loss of 7,000,000 head indicated. Thus it may be computed that a billion pounds of food went to waste.

In antihog-cholera serum a practicable means of immunizing hogs against the disease is available, and the Federal Government is spending $500,000 a year in a campaign carried on in cooperation with State agencies for the purpose of demonstrating methods of control and eradication.

Texas fever is a disease the control of which is of national importance, but in addition its conquest is a task the accomplishment of which is essential for the proper agricultural development of the South. Certainly no disease exists that exerts such a blighting influence on a section of the country as the parasitism of cattle by the cattle ticks and this disease transmitted by them.

Ticks considered merely as parasites furnish a cause of irritation that induces continual suffering and restlessness with consequent lack of thrift and prevention of gain in weight. It has been estimated that ticks in one season may abstract several hundred pounds of blood from a victim, which thus starves amidst plenty of food. The wounds caused by the points of attachment of the ticks permanently injure hides and afford points of entry for the screw worm.

But the effects of the disease transmitted by the tick constitute a greater loss of animal industry. Within the tick-infested area it exacts a continuous toll of death of native cattle. After a nonfatal attack the growth and development of the victim is either temporarily or permanently arrested and a "scrub" results.

The South needs improved beef stock, but the high probability of the death of the susceptible fine-blooded animals when introduced from without the tick area constitutes an obstacle against their purchase. This fact prevents even the showing of good cattle in districts where shows are most needed for their effect in stimulating improvement in stock.

The dairy cow is a highly nervous organization, very susceptible to injurious influence from parasitism and disease. The repressive influence of Texas fever upon the dairy industry of the South is marked. Experiment has shown that during a period of 152 days during the height of the tick season a group of

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tick-infested cows produced 42 per cent less milk than a similar lot of cattle free from ticks. On a herd of 20 cows this loss was computed to be $3.50 a day.

The quarantine restrictions necessary to protect the rest of the country against the outward movement of tick-infested cattle constitute a charge upon every pound of beef produced in the South. Quarantine lines must be maintained, cattle must be inspected, cars must be disinfected, etc. In one year about 900,000 head of cattle are shipped out under the increased expenses incident to their origin within the tick belt.

Diversification is deemed to be the one great need of agriculture in the South. The dairy cow particularly with reference to maintenance of soil fertility has ever been considered an important factor in a well-balanced system of diversified agriculture. Further, there exists the economic need for the production of dairy products in the movement away from the one-crop system in southern agriculture.

In recognition of the supreme importance of ridding the southeastern portion of the United States from ticks and the train of economic evils induced by them, there was inaugurated in 1906 a campaign of eradication with the aim of eliminating the annual loss from ticks, variously estimated as amounting to $40,000,000 to $100,000,000. Progress to the extent of 275,000 square miles[1] freed of ticks has been made. In 1914, 28,704 square miles were freed, and in 1915 about 50,000 square miles. There remains an area less than twice that already freed. The project appeared utopian when undertaken, but progress has proved it to be thoroughly practicable.

Recently an estimate has been made of the results upon the animal industry achieved in the areas that have already been freed of ticks. Inquiries from a wide variety of sources showed an average increased value of $9.76 per head of cattle, increases of 19 per cent in weight of cattle, 26 per cent in quality, and 23 per cent in milk production. The cattle industry has improved in general, as has likewise the raising of pure-bred cattle.

Probably no cattle disease is more widely distributed in this country than contagious abortion. In preventing reproduction at a normal rate and in affecting a large percentage of animals in a herd it strikes at the beef and dairy cattle and breeding business at a vital point. It is asserted that few breeders of long experience can deny having suffered losses from abortion. It has been estimated that the annual losses in dairies in New York State alone amount to $10,000,000 a year and evidence indicates like losses elsewhere.

The significance of the train of sequelæ more or less definitely proved to be associated with it constitutes a broad subject under investigation at present. It will suffice to state that sterility, premature birth, granular venereal disease, retained afterbirth, metritis, mammitis, together with white scours and pneumonia in new-born calves, have been more or less definitely and conclusively proved to accompany or follow abortion. Abortion and the accompanying pathological conditions may be successfully combated by a system of disinfection of animals, at a cost per animal which has been estimated at $4 a year for labor and disinfectants.

Blackleg, a disease of calves, formerly exacted a toll of 10 per cent of the annual calf crop. The Bureau of Animal Industry prepared and distributes a vaccine which has reduced the mortality where used to one-half of 1 per cent. During the fiscal year 1915 there were distributed to stockmen 3,454,628 doses, an increase of over a million doses over the preceding year.

In countries where foot-and-mouth disease exists it constitutes a source of an annual loss of from $8 to $10 per bovine animal. The loss is incurred rarely

[1] On Sept. 15, 1916, 294,014 square miles had been freed of ticks, leaving 434,529 square miles still under quarantine.

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by the death of adult cattle, but calves more commonly die. However, the bulk of the losses accrue from decrease of weight and temporary arrest of growth through cessation of eating, by the stoppage of milk secretion, and by injury to the udders of dairy cattle.

The recent outbreak in the United States that involved 22 States and the District of Columbia has been stamped out by vigorous measures. While individual losses and inconvenience were great, the price paid by the country at large was cheap as compared with the evils that would have accrued from the permanent implantation of the disease in this country.

The last report of the Secretary of Agriculture in discussing the annual direct loss from animal diseases in the United States at approximately $212,000,000, distributed as follows: Hog cholera, $75,000,000; Texas fever and cattle ticks, $40,000,000; tuberculosis, $25,000,000; contagious abortion, $20,000,000; blackleg, $6,000,000; anthrax, $1,500,000; scabies of sheep and cattle, $4,600,000; glanders, $5,000,000; other live-stock diseases, $22,000,000; parasites, $5,000,000; poultry diseases, $8,750,000.

As regards cattle, a 10-year average shows that 20.5 head per thousand die from disease. The figure for 1913 was 19.8. Losses from exposure in 1913 amounted to 10.9 per thousand as compared with the 10-year average of 16.5 per thousand.

The group of preventable diseases of the horse, which is of importance in influencing the abundance of draft animals and indirectly affecting the cost of food, will be passed over with bare mention. Likewise, the total high loss occasioned by internal and external parasites of meat-producing animals will be passed over in a cursory way.

The public health aspects of animal diseases in itself is a topic embracing so many details that it can be barely mentioned in this place. It may be noted that of the specific infectious diseases of meat-producing animals anthrax, actinomycosis, and tuberculosis are common to man. In addition to these the less specific bacterial infections of animal origin transmitted through milk constitute matters of importance in milk hygiene. Certain parasites of animals, like tapeworms and trichina, are transmissible to man.

The source of loss occasioned by poisonous plants existing on sheep ranges is receiving attention by the Bureau of Animal Industry. Observations indicate that ability of herders to recognize harmful plants, together with care in avoiding them, may reduce losses.

The poultry industry in this country is so extensive that the annual production is estimated to be one-half that of the cotton crop. There is a widespread disease, white diarrhea, transmitted through the egg, and capable of inducing a 100 per cent mortality of the freshly hatched chicks. The group of diseases commonly designated as roup, diphtheria, and bird pox inflict great losses on young and adult birds. Blackhead of turkeys has profoundly influenced the turkey industry in Rhode Island and elsewhere. Tuberculosis and fowl cholera are common in various parts of this country. The prevalence and effects of various parasitisms are well known.

The introduction of the system of substituting incubators and brooders for the hen has brought with it a series of difficulties causing death of chicks. Further, the assembling of large numbers of chicks together as compared with the numbers with the hen has increased opportunities for the spread of infection.

There have been pointed out some of the more important sources of loss from disease among our food-producing animals which limit production and increase expense. They correspond to the leaks that are discovered and eliminated in well-regulated business concerns. The figures involved are enormous and the possibilities for saving are of corresponding magnitude.



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The problem of animal disease in relation to food supply is identical in cause with the public-health problem. To protect our health and prolong our lives we are put to certain expense and inconvenience by public agencies and individual effort. In the case of animal diseases the object is primarily profit, but we must exert similar efforts to accomplish the desired result.

Notwithstanding the similarity between the problem of animal disease and the public health problem, there is a marked difference in the conditions under which preventive measures against diseases of man and of animals may be carried out. The conditions in general favor the success of efforts aimed at the eradication of animal diseases through the fact that it is possible to control absolutely the life and liberty of the individual. The measures of quarantine and the slaughter of sick and exposed individuals employed in combating foot-and-mouth disease obviously can not be applied in human prevention.

Whenever large numbers of men, grapevines, apple trees, or cattle are assembled permanently, diseases and pests appear and must be fought. The good judgment and knowledge possessed by the individual producer of animal food products concerning the diseases of his animals will determine his success. As the general average of knowledge of all producers rises so will diseases be correspondingly diminished.

Mr. HOOKER. I would like to ask Mr. Ward what he found in his investigations in regard to tuberculosis in tropical America?

Mr. MAYO. I held many autopsies on animals in Cuba, and I never saw a case of bovine tuberculosis except on an imported animal from the United States or England. I have seen it very extensive, however, in swine, but I attributed that very largely to human infection. At one of the National Insane Asylums in Cuba a large herd of swine was wiped out with tuberculosis, but there they feed the swine on the scraps from the tables of the patients, swept up from the floor, and the probabilities of infection in that way were very great.

Mr. WARD. I would say the same is true in the Philippines. I have never seen tuberculosis in native animals. It is always in those imported from Australia and the United States. The same is true in Japan; the native Japanese stock is rarely ever tuberculous.

Mr. RAWL. Is it as prevalent among human beings in that country as it is here?

Mr. WARD. More so.

Mr. RAWL. What is the absence of it among cattle and swine due to?

Mr. WARD. I do not say it is absent in swine; I think we have a due amount of it. The pig is the scavenger in the Philippines.

Mr. RAWL. Dr. Mayo, what do you think about it?

Mr. MAYO. I do not know.

Mr. RAWL. Do you think their cattle have any great qualities of resistance?

Mr. MAYO. They certainly have some qualities in various lines that may account for the fact. Of course most of the cattle in Latin America have quite a strain of the East India breeds and of the

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Boss Indicus type. There are certain pecularities about these animals that make them quite resistant to external parasites as compared with the European cattle; and it is probable that this resistance also holds good with reference to some of the animal diseases. I am unable to state, for instance, in regard to other diseases. My impression is that the freedom from tuberculosis is due to an inherent virility of the cattle themselves and also to the conditions under which they are generally raised. Dr. Ward does not think that conditions have so much to do with it, but certainly tuberculosis in the human family is much more frequent in the Tropics, and yet in cattle, at least in native cattle, it is practically unknown.

Mr. RAWL. I wish very much it had been possible for the significance of this subject to be appreciated by about 99 per cent more people of the country. It certainly lies at the very foundation of our agricultural development and prosperity.

The CHAIRMAN. I shall now call for the next paper, "Recent progress in the development of methods for the control and treatment of parasites of live stock," by Mr. B. H. Ransom, of the Department of Agriculture.

## RECENT PROGRESS IN THE DEVELOPMENT OF METHODS FOR THE CONTROL AND TREATMENT OF PARASITES OF LIVE STOCK.

By B. H. RANSOM,

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Methods for the control and treatment of parasites of live stock necessarily vary with different parasites and must also vary to fit various conditions. Inasmuch as the number of species of parasites affecting domesticated animals is large, 1,000 species, more or less, having been reported, and as conditions in various parts of the world and in the same place at different times are very different, it would obviously be impossible within the limits of a 30-minute paper to take into consideration all of these parasites. In the great majority of cases discussion could be limited to the statement, methods of control and treatment unknown, but the species that were left would still be too numerous to be discussed adequately except at book length. Furthermore, there are several species of parasites, each one of which could be given a small volume of discussion with reference to control and treatment. Accordingly, in view of the time limit, it is my intention to take up only a few of the parasites of live stock and to give consideration chiefly to recent developments in methods of control and treatment, particularly to discoveries made during the last 10 years.

The possibility of eradicating the Texas fever tick (*Margaropus annulatus*) became evident nearly a quarter of a century ago, when the principal facts in its life history were established, and somewhat later Curtice, Butler, and

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others furnished practical demonstrations by eradicating ticks from certain localities. It was not until 1906, however, that tick eradication was taken up in earnest on a large scale in the United States. The result of a little more than eight years' work up to January 1, 1915, has been the release of about 225,000 square miles of formerly tick-infested territory from quarantine, nearly one-third the original quarantine area of about 730,000 square miles.

Leaving out of consideration the question of improvements in administration, organization, etc., the most important change in methods of tick eradication since the beginning of the undertaking has been the adoption of the arsenical dip as an agent for the destruction of ticks. Other remedies had for one reason or another proved partial or complete failures, but the arsenical dip after a number of modifications was found to be very satisfactory, and since it has come into general use eradication has progressed by leaps and bounds. Portable testing outfits for the rapid determination in the field of the percentage of arsenic in dipping baths have been recently devised, and have proved very useful in tick eradication work (Chapin, 1914).

The spontaneous oxidation and reduction of arsenical dipping baths reported by Fuller (1911) and others are phenomena of considerable practical importance as there is a difference in the efficacy of oxidized and unoxidized arsenical baths. For example, a bath containing originally a certain amount of arsenic in the form of sodium arsenite, may become more or less oxidized, with transformation of more or less of the sodium arsenite into sodium arsenate, which is less efficacious against ticks. Consequently, this bath might then fail to destroy ticks upon the cattle dipped in it. The field test, however, which shows the amount of arsenic present in the arsenite form, makes it possible to determine readily whether a given bath is up to standard in so far as the percentage of arsenite is concerned. Another question arises, whether a bath low in arsenite can be strengthened by adding enough fresh concentrated dip to bring it up to standard, without at the same time increasing the total amount of arsenic (arsenite+arsenate) to a point where it is dangerous to cattle. Recent experimental work has indicated that strengthening the bath in this manner may be done without injury to the cattle, even though the total amount of arsenic is raised much higher than it is ever likely to be in practice. The field test thus makes it possible to use the same dipping bath repeatedly, with the assurance that it will be at the proper strength each time it is used, more arsenic or more water being added according as the test shows the percentage of arsenic to be too low or too high.

Comparatively little new has been added recently to our methods of handling scabies. Field-testing outfits for lime-sulphur and nicotine dipping baths, the two most efficacious remedies for scabies of cattle and sheep, promise to be as useful as the testing outfit for arsenical baths (Chapin, 1915). In connection with sheep scab it is of interest to note that Wolffhügel (1913) has called attention to the occasional persistence of scab mites in the ear and infraorbital groove of sheep which have been dipped, and has suggested that many failures to cure scab may be traced to this circumstance.

Great progress has been made in the United States toward the eradication of scabies of sheep and cattle. Fifteen years ago these diseases were widespread and were causing heavy losses. By means of quarantine restrictions and dipping the two diseases have been so reduced that only very small areas remain under quarantine.

Within the last few years in Europe organized attempts have been begun toward the eradication of warble flies. Associations for the destruction of warbles have been formed in France and Germany, supported largely by the

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tanning industry. Repeated demonstrations have been made, notably in Denmark, that the systematic removal of warbles from the backs of cattle results in fewer warbles the following year, and that if this practice is continued from year to year they finally become practically extinct in a locality where all the cattle are thus handled. Gläser (1913) and Carpenter and Hewitt (1914) have shown that the newly hatched larvæ of warble flies (both *Hypoderma bovis* and *H. lineatum*) may penetrate directly through the skin, and have furnished evidence which indicates that this is probably the common mode of infection. Infection through swallowing the larvæ is likely the unusual mode of infection, if it occurs at all. In connection with tick-eradication work in the Southern United States, it has been observed that cattle dipped repeatedly throughout the summer following the usual routine are commonly free or almost free from warbles the next year. Apparently the dipping deters the flies from depositing their eggs, or destroys the vitality of the larvæ either before or after hatching—more likely the latter, as the repellent action of arsenical dips is comparatively slight and transitory. It is perhaps possible that the arsenic stored up in and on the skin, as it is known to be in cattle which are dipped repeatedly, is sufficient to kill the newly hatched larvæ which attempt to burrow through the skin. The adult fly is prevalent only in certain months of the year, the season of prevalence probably varying in different localities according to differences in climate and other conditions. Naturally the question of the best time for dipping, assuming that the arsenical dip reduces the number of warbles by destroying the eggs or newly hatched larvæ, depends on the time of year the adult fly is active. This has not been determined for many localities, but there is reason to believe that the period of its activity in any one place is limited to a few weeks, and it is not unlikely that it will be found that a few dippings at the proper time of year is all that is necessary to bring about the eradication of warbles. In this connection it may be noted that after the larvæ have reached the later stages of development beneath the skin of the back, dipping seems to have comparatively little effect upon them. At least, I have observed in one case that, after two dippings a couple of weeks apart, very few of the warbles present beneath the skin of the cattle dipped were killed by the treatment.

The apparent efficacy of arsenical dips when used under certain conditions as a preventive against warbles suggests that they may possibly be used to advantage against similar pests, such as *Dermatobia noxialis* prevalent in various parts of South and Central America and Mexico and known colloquially as berne, torcel, gusano, etc.

From the recent researches of Surcouf (1913), Gonzalez-Rincones, and others, it appears that the life history of this parasite is as follows:

The adult fly deposits its eggs in holes in trees, these eggs which have sticky pedicels become attached to the bodies of mosquitoes which frequent such places, and by them are carried to cattle and other animals. While the mosquitoes are in the act of sucking blood, the larvæ escape from the eggs and then bore into the skin of their host. The larvæ having completed their development fall to the ground, pass into the pupal stage, from which in due course of time the winged fly emerges. Possibly, however, the attachment of the eggs to the mosquito is an accident rather than a necessity in the life history, and results merely because the fly is attracted by the odor of blood emanating from the gorged mosquito, which remains quiet in its torpid, full-fed condition while the fly deposits its eggs upon it or in its immediate vicinity, some or all of the eggs because of their sticky shells adhering to the mosquito, by which they are afterwards carried about. Instead of this seemingly very uncertain mode of

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infection it may be in the usual course of events that the fly is attracted by cattle and other animals which serve as hosts and deposits its eggs directly upon their bodies (in which event, however, it would seem that some one would have observed the eggs before this time), or perhaps the eggs are deposited upon grass, litter, or other material with which cattle and other animals frequently come in contact, and from which the larvæ after hatching readily reach their hosts by their own efforts. In any event, if infection occurs solely or chiefly as a result of the young larvæ penetrating the skin from without, irrespective of the way in which they reach their hosts, and if the fly is active only during a limited portion of the year the chances seem very good that the pest may be controlled by the dipping of live stock.

The screw worm (*Chrysomyia macellaria*) is another pest against which arsenical dips may often be used to advantage. It has been noted that screw worms are commonly destroyed when animals suffering from their attacks are dipped in the arsenical solutions used against ticks. Chloroform has been one of the most generally used screw-worm remedies for local application, but in recent years gasolene has commonly been employed as a substitute with satisfactory results.

The problems of control and treatment in the case of internal parasites are generally much more difficult than in the case of external parasites. Progress, however, is being made toward practical solutions of many of these problems. In recent years a great deal of work has been done upon various protozoan parasites, particularly those occurring in the blood. Commonly the control of these parasites depends upon controlling the insect vectors, or upon the destruction of certain animals which serve as reservoirs of infection, from which the parasites are carried by biting insects to domesticated animals. In some cases encouraging results have been obtained from treatment with different remedies, especially organic compounds containing arsenic.

Besides the Texas fever parasite, the only known species of protozoa occurring in the blood of the larger domestic animals in the Western Hemisphere are *Trypanosoma equiperdum*, *T. equinum*, *T. hippicum*, *T. venezuelense*, and *T. americanum*. The last, which is common in the blood of cattle (Crawley, 1909; 1912), is probably the same as *T. theileri;* it apparently is not pathogenic. The other four trypanosomes are all parasitic in horses. *T. equiperdum*, the cause of dourine, is transmitted directly from horse to horse by sexual contact; the mode of transmission of the others is unknown, likewise no satisfactory treatment or method of control has been developed for *T. equinum* (the cause of mal de caderas), *T. hippicum* (the cause of murrina), or *T. venezuelense* (the cause of peste boba, a disease very similar to mal de caderas). Because of the mode of transmission of dourine its control is essentially a simple matter, namely, by means of quarantine, slaughter of affected animals, castration, etc. A great practical difficulty, however, has existed in the occurrence of latent cases without definite clinical evidences of the disease. This difficulty has been solved through the application of the complement fixation test to diagnosis (Mohler, Eichhorn & Buck, 1913), so that it is now possible by taking blood samples from all the horses in a given locality to determine definitely which ones are affected, thus rendering possible the eradication of the disease which otherwise could scarcely be accomplished.

The larvæ of *Gastrophilus*, commonly known as bots, have lately attracted particular attention in view of the assertions of the Seyderhelm brothers (1914) that they are the cause of infectious anemia, the symptoms of which may be produced artificially by the injection of substances isolated from the bodies of these insects. Bot-fly larvæ are very resistant to most chemical agents, in-

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cluding alcohol and strong acids, but about 20 years ago Perroncito (1895) demonstrated that carbon bisulphide administered in capsules and followed by a cathartic is a very effective means of removing them. Since then no better treatment has been discovered. Very little has been added in recent years to our knowledge of the control and treatment of other parasites of the digestive and respiratory tracts of horses. It should be noted, however, that the carbon bisulphide treatment used for bots has also been found to be more or less effective against the common intestinal roundworm (*Ascaris equorum*). The use of atoxyl subcutaneously and intravenously with apparently successful results as a remedy for intestinal strongyles is an interesting development in methods of treatment (Bochberg, 1909, and others). The discovery (Ransom, 1911, 1913) that the nematodes, formerly known as *Spiroptera microstoma*, which often occurs in enormous numbers in the stomachs of horses, comprise two species, and that one of these (*Habronema muscæ*) occurs in its intermediate stage in the common house fly, points out the way by which one of these species at least may be controlled, namely, by controlling the house fly. With one or two exceptions satisfactory methods of control or treatment have not yet been devised for any of the various species of parasites occurring in the digestive and respiratory tracts of ruminants. The life histories of the tapeworms of ruminants are still shrouded in mystery, consequently no rational methods of control have been developed. Medicinal treatment for these parasites is generally unsatisfactory.

There are few new developments with reference to the control of liver flukes. Avoiding wet, marshy pastures, or draining such pastures so that conditions will no longer be suitable for snails, the intermediate hosts, still remains the classical method of preventing trouble with liver flukes. Railliet, Moussu, and Henry (1911) have suggested the use of lime on fluky pastures, having discovered that very weak solutions are destructive not only to fluke embryos but also to snails, and recommend that 500 to 1,000 kilograms be used per hectare, the applications to be made during the summer months. The same investigators found that extract of male fern eliminated liver flukes from sheep when administered once a day at least four times in doses of 5 grams per 30 kilograms of body weight. Hutyra and Marek (1913) failed, however, to get similar results in cases of liver fluke infestation in cattle. Male fern it may also be noted (Ransom and Hall, 1912) failed to expel fringed tapeworms (*Thysanosoma actinioides*) from sheep in several cases in which it was tried.

A few years ago Dalrymple (1906, 1907) tried the plan of raising lambs with their mothers in pens free from vegetation, feeding dry feed and cut green fodder. The animals were fed from raised racks, and the ground was kept as clean as possible by the frequent removal of litter and manure. This method, which has been termed Dalrymple's bare-lot method, is quite effective in preventing infestation with nodular worms (*Oesophagostomum columbianum*), lambs raised by this method usually remaining almost free from the parasites. The same method is less effective against stomach worms (*Huemonchus contortus*) and various other roundworms.

Many of the details in the life history of the stomach worm have been determined (Ransom, 1906, 1908), but an altogether practical method of controlling this parasite has not yet been worked out. The period of development of the larvæ to the infectious stage after the eggs of the parasite have been dropped upon the pasture in the feces of infested animals is so short in warm weather, and the longevity of the larvæ on pastures is so great, that a scheme of rotation, which will be at the same time generally practicable and fully effective in preventing the spread of the parasites from infested to noninfested

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sheep, seems out of the question. So many pastures or fields would be required, the sheep would have to be moved so often, and they could not return to the same pasture for so long a time, that a perfect rotation system would ordinarily be quite impracticable. As an indication of some of the conditions which have to be met, and of some of the difficulties which stand in the way of controlling stomach worms, it may be noted that the eggs of the parasites during the summer months hatch in a few hours and the larvæ develop to the infectious stage within a week after the eggs are dropped on the pasture. The larvæ then crawl up blades of grass, thus placing themselves in a position which specially favors their being swallowed by grazing animals. After the larvæ have reached the infectious stage they may live a long time on the pasture, though they no longer feed and ultimately die without further development unless they reach a suitable host. In this stage they are also very resistant, and may be frozen repeatedly, and kept in a dried condition for long periods of time without losing their vitality. A field vacated over seven months, from October to June, was found still to contain living larvæ when tested by placing noninfested lambs in it. It appears quite probable that larvæ may develop to the infectious stage on the skin of sheep in adherent fecal material—in fact, they have been found in that location—so that there is an evident possibility that lambs may become infected from the skin of their mothers while suckling. Whether infection may occur, as in the case of the hookworm, by penetration of the larvæ through the skin as well as by way of the mouth is not known. The larvæ when swallowed by a suitable host develop to egg-producing maturity in two to three weeks, so that a period of three or four weeks is sufficient for the completion of the life cycle. The adult worms may live many months in the stomach of their host and have been found still present in small numbers in sheep kept a year and a half on a board floor and handled in such a manner that the chances of fresh infection were reduced to a minimum. The average length of life, however, is probably much less than this; furthermore, it is not certain that any lived as long as 18 months in view of the fact that the possibility of reinfection was not altogether excluded.

In view of the various difficulties that stand in the way of preventing infection with stomach worms, the problem of control is apparently a hard one. Fortunately there are various medicinal remedies which are more or less efficacious against stomach worms, and if satisfactory rotation methods can not be discovered it is likely that a practical solution of the stomach-worm question may be accomplished with the aid of some sort of medicinal treatment, just as the use of arsenical dips has proved to be the solution of the tick-eradication problem. Considerable work on a small scale has already been done in the Bureau of Animal Industry upon the question of controlling stomach worms, and recently more extensive investigations have been undertaken, with the inauguration of experiments to be carried on under approximately practical conditions upon a farm of 160 acres leased for the purpose near Washington.

In the case of the hookworm of sheep (*Bunostomum trigonocephalum*) so far as observations have been made, less rigorous rotation methods seem necessary to prevent infestation than in the case of the stomach worm. On the other hand hookworms and other intestinal parasites in ruminants respond much less readily to medicinal treatment by way of the mouth than those located in the stomach. In fact no uniformly satisfactory medicinal treatment for such parasites is yet available. Brumpt, however (see Railliet, 1915), has had very successful results in destroying nematodes in the large intestine of ruminants by injections of an emulsion of thymol per anum. Owing to the time and trouble involved in this method of treatment it is not likely to be commonly used.

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In the treatment of lungworms in cattle (*Dictyocaulus viviparus*) Scheibel (1907) has had good results with a mixture of creosote and dilute alcohol sprayed into the trachea by means of a special apparatus, consisting of an atomizer and a canula, which is inserted into the trachea through an incision in the neck and held in place until the completion of the course of treatment, three treatments being given either on the same day or on three successive days. This also is a very troublesome method of treatment, and hence not likely to prove generally useful. A newly recognized difficulty in controlling lungworms is presented by the occurrence of these parasites (*Dictyocaulus filaria*) in newly born and fetal lambs (Neveu-Lemaire, 1912).

Recent investigations in the Bureau of Animal Industry indicate that oil of chenopodium, which has come into common use recently in the treatment of man for hookworms, is a very efficacious remedy against the common roundworm of hogs (*Ascaris suum*).

The discovery (Bernard and Bauche, 1913, 1914) that the larvæ of *Stephanurus dentatus*, the hog kidney worm, gain entrance to their host through the skin as well as through the mouth is of considerable interest in connection with the question of controlling this parasite, which is a great pest in the southern United States, in the Orient, in Africa, and no doubt also in parts of Central and South America. The development of a successful medicinal treatment for this parasite seems unlikely, hence preventive measures appear to offer the only hope of controlling it. In parts of Asia where it is prevalent slat floors in the hogpens raised from the ground have been found to be an effective preventive against serious infestation with kidney worms.

With reference to the various species of parasites of live stock for whose prevalence the nuisance of unrestricted dogs is responsible, and whose control depends upon properly controlling dogs, it is of interest to note that another parasite has recently been added to the list by the discovery (Ransom, 1912; 1913) that the muscle cysticercus of sheep known as *Cysticercus ovis* is the intermediate stage of a previously unrecognized tapeworm of the dog (*Taenia ovis*). This parasite is very common in the United States and probably also in other countries. During the last fiscal year 39,639 sheep carcasses out of a total of 12,909,089 slaughtered under Federal inspection were retained on account of infestation with this parasite—about 0.3 per cent. Owing to the difficulty of discovering the parasite many cases of infestation are undoubtedly overlooked, and the percentage of sheep infested is probably much greater than that given.

This parasite affords an additional argument for the elimination of vagrant dogs and the proper control of other dogs. Considerable progress has been made in recent years toward the suppression of unrestricted dogs in the United States; various sheep breeders' associations have taken an active interest in the matter, and several States have enacted legislation bearing upon the protection of the live-stock industry from the dog nuisance. As yet, however, only a beginning has been made in bringing about a proper control of dogs, and any great reduction in the prevalence of parasites of live stock which are transmitted by dogs is not likely to be observed until live-stock owners appreciate more generally than they do to-day the importance of these animals as disease carriers (Hall, 1915).

REFERENCES.

Bernard, P. Noël; & Bauche, J.:

1913.—Influence du mode de pénétration, cutanée ou buccale, du *Stephanurus dentatus* sur les localisations de ce nématode dans l'organisme du porc et sur son évolution <Compt. rend. Acad. d. sc., Par., v. 157 (1), 7 juillet, pp. 74–76.

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Bernard, P. Noel; & Bauche, J.—Continued.

1914.—Influence du mode de pénétration, cutanée ou buccale du *Stephanurus dentatus* sur les localisations de ce nématode dans l'organisme du porc et sur son évolution <Ann. de l'Inst. Pasteur, Par., v. 28 (5), mai, pp. 450–469, figs. 1–2, pl. 14, figs. 1–6.

Bochberg:

1909.—Beitrag zur klinischen Diagnose und Behandlung der Sklerostomenseuche <Ztschr. f. Veterinärk., Berl., v. 21 (6), 2. Juni, pp. 271–275.

Carpenter, George H.; & Hewitt, Thomas R.

1914.—The reproductive organs and the newly hatched larva of the warble-fly (*Hypoderma*). [Read Feb. 24] <Scient. Proc. Roy. Dubl. Soc., n. s., v. 14 (19), Apr., pp. 268–289, figs. A–B, pls. 21–26, figs. 1–37. [Issued Apr. 29.]

1914.—Some new observations on the life-history of warble-flies. The entrance of the maggot into the host's body <Irish Naturalist, Dubl., v. 23 (10), Oct., pp. 214–221.

Chapin, Robert M.:

1914.—Laboratory and field assay of arsenical dipping fluids <Bull. 76, Bureau Animal Indust., U. S. Dept. Agric., Wash., Apr. 29, pp. 1–17, fig. 1.

1914.—Arsenical cattle dips: Methods of preparation and directions for use <Farmers' Bull. 603, U. S. Dept. Agric., Wash., Aug. 14, 16 pp., fig. 1.

1915.—A field test for lime-sulphur dipping baths <Bull. 163, Bureau Animal Indust., U. S. Dept. Agric., Wash., Jan. 12, pp. 1–7, fig. 1.

1915.—Studies on changes in the degree of oxidation of arsenic in arsenical dipping baths <Bull. 259, U. S. Dept. Agric., Wash., pp. 1–12.

Crawley, Howard:

1909.—Studies on blood and blood parasites. 1. Observations on mammalian blood with dark-field illumination. 2. The priority of *Cryptobia* Leidy, 1846, over *Trypanoplasma* Laveran and Mesnil, 1901. 3. *Trypanosoma americanum* n. sp., a trypanosome which appears in cultures made from the blood of American cattle. (Preliminary notice) <Bull. 119, Bureau Animal Indust., U. S. Dept. Agric., Wash., Oct. 22, pp. 1–31, figs. 1–3.

1912.—*Trypanosoma americanum*, a common blood parasite of American cattle <Bull. 145, Bureau Animal Indust., U. S. Dept. Agric., Wash., Jan. 17, pp. 1–39, figs. 1–15.

Dalrymple, W. H.:

1906.—Nodule-disease of the intestines of sheep. "Bare-lot" method of raising lambs. Results of further experimental work <Bull. 89, Louisiana Agric. Exper. Station, Baton Rouge, Dec., pp. 1–11, figs.

1907.—Bare-lot vs. grass-lot in relation to stomachal and intestinal parasitism of lambs. Further experiments <Bull. 95, Louisiana Agric. Exper. Station, Baton Rouge, Sept., 23 pp., 6 figs.

1907.—Stomachal and intestinal parasitism of lambs. Bare lot vs. grass lot <Vet. J., Lond. (388), v. 63, Oct., pp. 584–589.

Fuller, Aubrey V.:

1911.—The spontaneous oxidation of arsenical dipping fluids <Circular 182, Bureau Animal Indust., U. S. Dept. Agric., Wash., Nov. 9, 8 pp.

Gläser, Hans:

1913.—Ueber Dasselfliegen. Neue Untersuchungen über die Lebensgeschichte der beiden Dasselfliegen des Rindes <Mitt. d. Ausschuss. z. Bekämpf. d. Dasselplage, Berl. (5), pp. 5–38, 1 l., figs. A–B, pls. 1–4, figs. 1–18.

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Hall, Maurice C.:
1915.—The dog as a carrier of parasites and disease <Bull. 260, U. S. Dept. Agric., Wash., Nov. 23, pp. 1–27, figs. 1–14.
Hutyra, Franz; & Marek, Josef:
1913.—Spezielle Pathologie und Therapie der Haustiere. 4., umgearbeitete und vermehrte Auflage. v. 2, xiv+1088 pp., 207 figs., 7 pls. 8°. Jena.
Mohler, John R.; Eichhorn, Adolph; & Buck, John M.:
1913.—The diagnosis of dourine by complement fixation <J. Agric. Research, Dept. Agric., Wash., v. 1 (2), Nov. 10, pp. 99–107.
Neveu-Lemaire, Maurice:
1912.—Strongylose bronchique congénitale du mouton <Compt. rend. Acad. d. sc., Par., v. 154 (20), 13 mai, pp. 1311–1312.
Perroncito, Edoardo:
1895 c.—Sui mezzi per combattere le larve d'estro (*Gastrophilus equi*) nello stomaco e nello intestino del cavallo. [Read 31 maggio] <Gior. r. Accad. di med. di Torino, an. 58, 4. s., v. 1 (10), ott., p. 482.
1895 e.—Idem. [Original] <Ibidem (2), feb., pp. 86–102.
1895 f.—Il solfuro di carbonio come mezzo per combattere le larve di ditteri nel tubo gastro-enterica <Gior. di med. vet., Torino, v. 44 (9), sett., pp. 346–348.
Railliet, Alcide:
1915.—L'emploi des médicaments dans le traitement des maladies causées par des nématodes <Rec. de méd. vét., Par., v. 91 (15), 15 août, pp. 490–513.
Railliet, Alcide; Moussu, G.; & Henry, A.:
1911.—Essais sur la prophylaxie de la distomatose <Compt. rend. Soc. de biol., Par., v. 70 (11), 24 mars, pp. 425–427.
1911.—Essais de traitement de la distomatose <Ibidem, pp. 427–429.
1911.—Essais sur la prophylaxie et le traitement de la distomatose. [Read before Soc. de biol., 18 mars] <Rec. de méd. vét., Par., v. 88 (7), 15 avril, pp. 232–238.
1911.—Recherches sur le traitement de la distomatose du mouton <Compt. rend. Acad. d. sc., Par., v. 152 (17), 24 avril, pp. 1125–1127.
1911.—Essai sur la prophylaxie et le traitement de la distomatose <Progrès vét., Agen, an. 24, 2. s., v. 32 (9), 10 mai, pp. 277–285.
1911.—Recherches sur le traitement de la distomatose du mouton <Rec. de méd. vét., Par., v. 88 (9), 15 mai, pp. 283–289.
1911.—Researches on the treatment of liver-rot in sheep. [Transl. of 1911, pp. 283–289, by J. R. U. Dewar] <Vet. Rec., Lond. (1200), v. 24, July 8, pp. 17–19.
Ransom, Brayton Howard:
1906 i.—The life history of the twisted wireworm (*Haemonchus contortus*) of sheep and other ruminants. (Preliminary report) <Circular 93, Bureau Animal Indust., U. S. Dept. Agric., Wash., pp. 1–7, figs. 1–2.
1908.—The prevention of parasitic infection in lambs. Report of first series of field experiments <23. Ann. Rep. Bureau Animal Indust., U. S. Dept. Agric., Wash. (1906), pp. 207–212.
1911.—The life history of a parasitic nematode—*Habronema muscae* <Science, N. Y., n. s. (881), v. 34, Nov. 17, pp. 690–692.
1912.—Cysticerci in American sheep, reindeer and cattle. [Note read before Helminthol. Soc. Wash., D. C., Mar. 14] <Science, N. Y., n. s. (903), v. 35, Apr. 19, p. 636.

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Ransom, Brayton Howard—Continued.

1913.—*Cysticercus ovis*, the cause of tapeworm cysts in mutton <J. Agric. Research, Dept. Agric., Wash., v. 1 (1), Oct. 10, pp. 15–58, figs. 1–13, pls. 2–4.

1913.—The life history of *Habronema muscae* (Carter), a parasite of the horse transmitted by the house fly <Bull. 163, Bureau Animal Indust., U. S. Dept. Agric., Wash., Apr. 3, pp. 1–36, figs. 1–41.

Ransom, Brayton Howard; & Hall, Maurice C.

1912.—The action of anthelmintics on parasites located outside of the alimentary canal <Bull. 153, Bureau Animal Indust., U. S. Dept. Agric., Wash., Sept. 25, pp. 1–23.

Scheibel, Albert.

1907 a.—Bronchitis verminosa der Rinder und die verschiedenen Behandlungsmethoden derselben <Deutsche tierärztl. Wchnschr., Hannov., v. 15 (48), 30. Nov., pp. 673–678, 2 figs.

Seyderhelm, K. R.; & Seyderhelm, R.

1914.—Die Ursache der perniziösen Anämie der Pferde. Ein Beitrag zum Problem des ultravisiblen Virus <Arch. f. exper. Path. u. Pharmakol., Leipz., v. 76 (3–4), 8.Mai, pp. 149–201, charts 1–10.

Surcouf, Jacques.

1913.—La transmission du ver macaque par un moustique <Compt. rend. Acad. d. sc., Par., v. 156 (18), 5 mai, pp. 1406–1408, figs. 1–2.

Wolffhügel, K.

1913.—Una de las causas de fracasos de los procedimientos actuales de extinción de la sarna <Rev. d. Ministerio de indust., Montevideo, v. 1 (4), agosto–set., pp. 32–35.

Mr. MAYO. I think that in all Latin America and particularly in tropical Latin America the parasitic diseases of domestic animals are the most serious plague with which the stockman has to contend. This, of course, includes the diseases that are transmissible by the ticks and which have proven such a great drawback to the introduction of the better breeds of animals as we know them in the United States of North America. The stockmen, usually the better class of stockmen in Latin America, have been willing to purchase valuable pure-bred animals from the older breeding countries, but the losses that have followed have been so tremendous that it has practically prevented, at least until comparatively recent years, the improvement from a beef or dairy point of view of the cattle of those countries. And not only the external parasites, but the flies and the internal parasites, particularly liver flukes, cause tremendous losses in Latin America. I would like to ask Dr. Ransom to what he attributes the present outbreak of lung worms in young cattle.

Mr. RANSOM. I have not been able to find any satisfactory explanation for that. We know, however, that lung worms are generally worse in certain seasons; that is, in very wet or very dry weather they are liable to be worse than they are under ordinary conditions. I have not looked up very carefully the weather records for the last year, but my impression is that it has been unusually wet.

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Mr. MAYO. I agree with Dr. Ransom fully that it is due to the unusual and rather steady rainy season that we have had. My observation has been that the losses in the dry season—the unusually dry season—are due more to lack of proper alimentation that reduces the vitality of the animal, and not to an undue prevalence of the parasites under those conditions.

Mr. WARD. In connection with the discussion of kidney worms I might say that that is a tremendously important factor in the Philippines. The Division of Animal Husbandry made a great effort to improve the Philippine hog by distributing improved stock, but they began to die of kidney worms as soon as they were received. The question of the injury that might be done to Philippine agriculture by sending out the survivors was taken up, and we made an examination of several thousand pigs in consecutive cases and found that in 50 per cent the pigs were infected with kidney worms.

Mr. CANNON. Perhaps you will be interested in my observations in Montana. I am not a veterinarian, but I have heard that some of the breeders of horses are discouraged. Montana would seem like a horse paradise, but in fact there are extensive regions there where it is necessary to fence off all the low places for fear of getting a kind of hookworm that goes hither and yon and through the horse and may develop anywhere. The horse gets sick and tires out by noon or in the middle of the forenoon. They do not know what is the matter, and the horse may die in three or four days. So, many men have become discouraged there and think they have to quit the breeding of horses in some of those regions.

Mr. WARD. I might say the importance of that was brought out in the investigations in regard to the effects of smelter fumes in Montana.

The CHAIRMAN. If there is no further discussion, this session will now stand adjourned.

Adjourned.

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## SESSION OF SUBSECTION 7 OF SECTION III.[1]

RALEIGH HOTEL,
*Tuesday afternoon, January 4, 1916.*

Chairman, CHARLES J. BRAND.

The session was called to order at 2.30 o'clock by the chairman.

Papers presented:

Municipal terminal markets, by Cyrus C. Miller.

The economic trend in wholesale method of fruit distribution, by Arthur R. Rule.

The influence of supply on prices, by A. U. Chaney.

The economic value of the auction as a distributor of perishable commodities, by Victor K. McElheny, jr.

Organization by consumers, by Herbert A. Smith.

### MUNICIPAL TERMINAL MARKETS.

By CYRUS C. MILLER,
*Of Miller and Bretzfelder, Counselors at Law, New York City.*

Individualistic spirit in America still prevails. While we do many things in a cooperative way, we still have much to learn in coordination. Man has not achieved, in this country at least, a position where he can earn sufficient to support himself and his family by working only part of his waking hours. This is because of much waste of effort. A coordination of our food-producing and distributing forces would lessen the amount of labor necessary for them and release the laborer for other activities. Every dollar's worth of waste in the process of feeding the people compels a dollar's worth of unproductive and useless labor.

Engel's law made from data furnished in a Belgian investigation in 1853, held that, as income increases—

1. The proportion of income expended for food decreases.
2. The proportion expended for rent, fuel, and light remains constant.
3. The proportion expended for clothing remains constant.
4. The proportion expended for sundries increases.

This law has been confirmed in this country by the United States Commissioner of Labor. If the money in hand is increased by the saving on food expenditures, the family, to the amount of the saving, can live in better quarters, and have more money for the desirable things of life, beyond what are necessary for mere existence. For the great mass of our citizens an increase in the

[1] There was no stenographic report of this session.



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cost of food means a lowering of the standard of living. For the city to be contented and efficient economically, an abundance of cheap food is necessary.

The New York Association for Improving the Condition of the Poor in its report for the year 1912–13 has prepared statistics showing the cost of maintaining a decent home for an average family of five persons in the city of New York to be $1,082.25, of which 48.4 per cent was expended for food. The average cost of 20 articles of food used by the workingman's family in 1890 was $1, while in 1914 it was $1.45.

The United States Bureau of Labor Statistics show a rapid increase in the retail prices of foods used in the average workingman's family between the years 1890 and 1912. The figures for recent years are as follows: 1905, $115; 1906, $119.10; 1907, $125.90; 1908, $126.50; 1909, $131.20; 1910, $135.20; 1911, $134.90; 1912, $143.70.

The census report further states that if the 75,000,000 inhabitants in 1900 had purchased all of the principal crops raised in that year at the values reported by the farmers they would have paid $35.42 each; that if the 91,000,000 inhabitants of 1910 had bought the output of the same crops in that year and paid for them on the basis of the prices that prevailed 10 years before they would have paid $32.21 each; but that by reason of the advance in prices they would actually have paid $53.59 each, an additional cost of $21.38 per capita, resulting from the increase of 66.4 per cent in prices.

In the meantime wages have not increased in the same proportion, so that the increased price bears most heavily on the poor, who must spend so large a part of their income for food.

In the marketing of the products of agriculture—the necessities of life—we are confronted with conditions new in the history of the world. The last few decades have seen wrought the most stupendous changes in the means of transportation and communication. The development of manufacturing and industries has changed the character of whole peoples and made nations of city dwellers of people whose ancestors lived close to the soil and themselves cultivated the things that gave them sustenance. We are past the time when life could afford to be organized loosely, and the interdependence of people was not great, when each family could produce and manufacture almost enough for its entire needs, and whether we regret it or not, we have new conditions before us, and our methods must be brought up to the times.

A railroad official states that the first shipment of early vegetables for the northern market was made by boat from Norfolk in 1855; that in 1912 the Pennsylvania Railroad alone hauled nearly 100,000 cars of truck products from the South; and that in 1913 it carried more than double the quantity of perishable freight from the South than it carried in 1901.[1] Such comparisons bring forcibly before us the nature of the change that has taken place, and indicate, too, the nature of the adaptions to present-day conditions that must be made.

The United States Census Report for 1910 states that the quantity of the principal crops produced in this country increased about 10 per cent between 1900 and 1910; that in the same period the total population increased 21 per cent and the urban population increased 34.8 per cent. The last figure given is most significant for us, because it indicates the increase in the number of people who are not food producers and who must be supplied by the others. In all but two States in the Union urban population increased more rapidly than

[1] Annals of the American Academy of Political and Social Science, November, 1913, p. 14.

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rural. The same report also states that during the period mentioned the export of foodstuffs from the country materially decreased, the decrease in the amount of breadstuffs exported amounting to 49 per cent. There is no lack of food supply yet to support our population, but it is plain that we are approaching nearer to the point when we shall not only consume all we produce, but be forced to import foodstuffs, unless measures be taken that will result in increased prduction and better distribution of the products of our farms. The less the surplus the greater the necessity of economical distribution if we are to prevent a sharp rise in prices.

The increase of the shipments of California citrus fruits from 1890 to 1915, as compared with the population, was as follows:

| Year. | Oranges. | | Lemons. | | Population. | |
|---|---|---|---|---|---|---|
| | Cars. | Per cent increase. | Cars. | Per cent increase. | Number of people. | Per cent increase. |
| 1890 | 3,476 | ..... | 34 | ..... | 62,947,714 | ..... |
| 1900 | 16,362 | 371 | 1,447 | 4,156 | 95,994,575 | 20.7 |
| 1910 | 28,252 | 72.7 | 4,891 | 258 | 91,972,266 | 21.0 |
| 1915 | 39,617 | 40.3 | 7,068 | 44½ | 99,961,111 | 8.7 |

It is evident that the volume of the staple crops shows a decreasing ratio per capita, as compared with the population, and a consequent increase of price, while certain perishable crops, as citrus fruits, show an increased volume per capita, which made it necessary for the producers of citrus fruits to find new markets for their produce. This they have done by a marvelous system of cooperation which only lack of space here forbids setting out in detail. The California Fruit Growers' Exchange has shown to the farmers of this country how they may combine to sell their goods.

In 1906–7 they sold in 886 car-lot markets at private sale; in 1909–10 they sold in 504 car-lot markets; and in 1914–15 in 628 car-lot markets. In addition to these private-sale points the exchange sells at auction in New York, Baltimore, Boston, Cincinnati, Cleveland, New Orleans, Philadelphia, Pittsburgh, and St. Louis. By careful and uniform methods of growing, picking, grading, and packing their produce, and buying transportation in carload and even train-load lots, and establishing what are practically wholesale terminal markets for their produce wherever practicable, they have succeeded in selling their produce at a profit in markets averaging 2,500 miles distant from their orchards. It is a fair presumption that if they had wholesale terminal markets in the large cities where other products were sold and the maximum of buyers congregated, instead of those who were interested in citrus fruits only, they could sell more goods, eliminate many trucking charges, and insure a lower price to the consumer.

From different causes, therefore, it is necessary to improve our methods of distributing both staple and perishable food crops.

Three years ago a witness before the mayor's market commission of New York City testified that there were enough peach trees in the orchards of western New York to produce a crop of 10,000 carloads of peaches in five or six years, and that unless facilities were improved for distributing them great loss would result. This prediction was proven true this year when quantities of peaches in northern New York State were left to rot on the ground. Fifteen years ago Delaware shipped out 9,000 cars of peaches in one year, and a few years ago Georgia shipped out 7,200 carloads. A recently published

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newspaper article stated that the apple crop in the Northwest for 1913 was approximately 10,000 cars of fruit; by 1916 it was estimated that the output will be at least 30,000 cars, and by 1920 a total of 60,000 cars. At present prices this will mean finding a market for $51,000,000 worth of fruit. Other districts throughout the country during the past 10 years have been planted in large areas with fruit and other food products which must be distributed among the cities and towns. The population of the cities has grown apace in the same period, but their markets have not kept pace either with the increase in production nor the potential increase in consumption. Producers' associations, railroads, and middlemen are effecting the best distribution of crops possible with the means at their command, but in the cities the best means available to-day are the makeshifts that survive a simpler system. There is a great necessity for modern terminal markets if the distribution of food products in the cities is to be helped. What is the use of raising vast quantities of foodstuffs if they can not be distributed? Bankruptcy confronts owner and consumer alike, unless our distributing facilities keep pace with our production. The farmer, the banker, the railroad man are engaged in the first part of the problem, namely, getting the food to the cities. The city man is engaged in bringing the food into and distributing it within the city. Neither group can prosper unless the consumer can buy the produce at a fair price.

The first question that presents itself is, What are the causes of these increased prices and why are they increasing? This question has been discussed and analyzed so admirably in recent publications that it seems hardly necessary for me to do more than briefly indicate the chief points involved in order to lead up to what I wish to say on the subject of municipal terminal markets.

The difficulty is not in any shortage in the food supply, but is in the fact that there is, under present conditions, necessarily and increasingly an element of service which adds to the cost—service in distribution. Our people in increasing proportion live in cities and cease to produce their own food. In 1910, of the 92,000,000 people in the country, one out of every 10 lived in either New York, Chicago, or Philadelphia. These nonproducers must therefore pay not only for the food and the labor of others in producing it, but also for transportation, for handling, for storage, for two or three sellings, and for all the processes of distribution through which foodstuffs must pass; and they must pay an increase in high prices when the influx of goods to a given center, which would tend to bring prices down, is retarded. The cost of living will be relatively high or low, according as these processes of distribution are efficiently managed or not, and according as the channels of trade are kept open or constricted. Elaborate analyses of food costs have shown that it is not the producer who is responsible for the high cost of living; it is not he who waxes fat on exorbitant prices; he often receives less for the product of his labor than the total cost of distributing it to consumers. Nor is it the railroads or the storage warehouses. Prof. King states[1] that 700 to 800 public warehouses in the United States store annually about 1,320,000 carloads of perishable goods, and that the charges are not excessive.

In fact, one object of the effort to establish better distribution is to help the producer by insuring better returns to him for the products of his labor. There is far more fluctuation in prices paid producers than in retail prices paid by consumers, because the latter, in any given season, tend to keep to an established level, being less subject to the influences of supply and demand that affect the wholesale market. If people are in the habit of paying a certain price for a certain product, it is by no means unusual for them to suspect

[1] "Lower living costs in cities," C. L. King.



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the quality of goods selling for less. The retailer of course takes advantage of this psychological process, and when he can buy cheaper is apt to take the added profit and leave his selling price at the usual figure.

In reports of price accumulation made to a committee of the National Municipal League by growers and others, the statement is made that "the difference in price between what the consumer pays and what the producer gets ranges from 100 to 300 per cent."[1] An investigation in the city of Philadelphia showed an excess of prices paid by consumers over those received by producers ranging from 67 per cent to 266 per cent, with an average increase of 136 per cent.[2] This indicates one great problem that faces us and that hitherto we have done little more than analyze. What can we as a people, through our city, county, State, or Federal organs of expression and action, do to facilitate the distribution of food products and lessen the enormous amount which it is now costing, both in actual money and in loss through bad methods?

We find that great strides have been made in the matter of transportation. The fast freight refrigerator-car service is now highly organized and has been developed by private capital to a high state of efficiency. It has been stated that it has made it possible for New York to get its food on an average of 1,000 miles inland on a four-day haul by fast freight; that the Middle West now produces two-thirds of our food supply.[2]

Very efficient work is also being done in the marketing of certain crops, through the organization of producers, standardizing grades and packages, and cooperative methods of selling.

But after these efficiently graded, packed, and transported products reach the city, what is the situation? System and efficiency seem suddenly to come to an end and guidance and direction to be absent. Wholesaling, jobbing, and retailing costs pile up; trucking, handling, gluts and scarcity, loss through waste, and other by-products of the lack of organization bring the cost of food up to the point that arouses public clamor.

In many cities of the country we find public retail markets, some survivals of an older order, and some newly planned and built with all modern improvements, and the interest in them that has been stimulated in the last few years has undoubtedly had a salutary effect upon prices in their vicinity, and has made the people feel more individual responsibility in the matter of their living costs and the effect of their choice of marketing places and their active interest in the subject. But these are not enough. The way is not yet open for the food products to get into the cities in the first place, and when there, to find a ready sale. There has as yet been no adequate development of markets at the terminals where the food products come in. There are only, in most cases, the makeshift minimum facilities which the transportation companies and the wholesale dealers provide.

This is growing to be a pressing problem because there is probably not a city of size in the country that receives the bulk, or even any great part of its foodstuffs from the surrounding country. Our city markets are supplied with vegetables from the South, citrus fruits from California and Florida, apples from Oregon or Arkansas or New York, potatoes from Maine or Long Island or Texas, and so on, the source of supply depending on the seasons and crops. The development of transportation facilities has made it possible to lengthen the season for fresh produce of all kinds in the centers which are

[1] "The relation of the city to its food supply," report of a committee of the National Municipal League, November, 1914.

[2] "Lower living costs in cities," C. L. King.

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large enough to take the articles in large lots. The unprecedented growth of our cities brings about a yearly increase in the number of car lot points.

There are many reasons why this should be so. The carload is the convenient and natural unit for rail shipments. Where goods are carried by water there is no such convenient unit for handling, and the freight rates on small lots are often but little higher proportionally than those on large lots. With rail shipments, however, the case is different. It is easier to divert a car in transit to any point desired than to unload and reload a small consignment; and in the matter of refrigeration the car-lot shipment is easier to manage than the small lot. These considerations have caused the railroads to make lower rates on car lots, so that such shipments are more profitable to the shippers. This has caused throughout the country a greater specialization of crops than heretofore existed, the growers desiring to be able to ship in large quantities and get the benefit of the low rates. An example of the difference in existing freight rates on large and small lots is given by Mr. Frank Andrews,[1] of the United States Bureau of Agriculture as follows: "The rate on peaches from Fayetteville, Ark., to Omaha, Nebr., in November, 1912, was 51 cents per 100 pounds, while on less than carload lots the rate was 99 cents per 100 pounds." The advantage of shipping in carload lots thus has a tendency to keep prices down, because it encourages specialization in the growing of certain products in the localities where they can be produced most cheaply.

For these reasons the increase of the practice of shipping in car lots has been rapid, as has also been the increase of the number of cities of the country which can take car-lot shipments. Mr. Andrews states that figures based upon reports from 42 cities indicated an average increase of 40 per cent from 1900 to 1910 in the number of car-lot markets for perishable produce, and that according to the report of one of the large merchant shippers of Jacksonville, Fla., in 1912, car-lot shipments of Florida produce were made to 210 different cities located in 46 States. It would be interesting to know what the marketing facilities in those 210 cities were. He further states that on a day in 1912 cantaloupes were quoted in New York from California, Virginia, and Georgia, while Colorado, New Jersey, Delaware, and Maryland were also among the States sending cantaloupes to this marked during the same year, and that Kansas City's lettuce supply in 1912 was taken from nearby fields, and also from California, Florida, New York, Louisiana, Colorado, Texas, and Arkansas, and no doubt from other States not mentioned in the price quotations.

It is quite evident, therefore, that a wholesale terminal market must have space and facilities for handling large quantities of produce brought to it by ship and rail.

In order for a town or city to have a wholesale terminal market the territory which it serves must be large enough and populous enough to support it. Some of the largest cities might support more than one wholesale market, but it is evident that a city must be of considerable size to support even one. This inability of the small city to absorb wholesale quantities and to attract direct shipments of produce from many distant places shows one reason why food prices are as high in the small cities as they are in the large cities, where their distribution is more complicated and expensive.

By municipal terminal market we mean two things—the physical equipment and the departmental control of it. The physical form of a terminal market, important as it is, is not so important as the system by which the distribution is governed.

[1] Annals of the American Academy of Political and Social Science, "Reducing the cost of food distribution," November, 1913.

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There are two theories of distribution in a large city by terminal markets—the centralized and the decentralized. The first, as its name signifies, calls for one large terminal market in a large city or a considerable subdivision of a large city. The other calls for several distributing terminal markets in different parts of the city.

At first glance it might seem that many savings might be made by having many terminal markets near the places of consumption, and having the produce brought to them by rail or water in carload or boat-load lots. Probably this would effect a saving in trucking charges in some instances, and if this were the only item of cost involved the weight of favor would be for decentralized markets, but the main objection to such a plan is that such markets would not attract either the maximum of supplies or buyers and fluctuations of prices would prevail. The decentralized system might be good for deliveries but not for sales.

It must not be forgotten that the distribution of food products differs from the distribution of other freight, because of the necessity of exposure for sale. Local freight stations will serve to deliver freight to a consignee, but food produce needs space and appliances for the conduct of sales. Hence markets are necessary.

A wholesale terminal market under control of a market department could be the center of market news of the greatest value to both producer and consumer. The market department should furnish daily market reports giving the quantities of produce in the market and their prices, and also the probable quantities within the next week or ten days. The information on the day's market and its prices would be useful to buyers in the city as a check on retail prices and to distant shippers for comparison with the prices their goods brought. Of course, such data would not be of much value unless the produce was graded and packed in standard containers. Uniform rules as to grades and containers could be adopted by the department and published for the information of shippers.

Facts upon which prediction of the probable future supplies in the market is made could be gathered by local agents throughout the country while the crops are growing, and by telegraphic despatches from the principal points of shipment. Such information of a few crops and of the state of the market for such crops is obtained now by private concerns at great outlay. One organization is reported to spend $75,000 annually for telegrams for this purpose and another $25,000. It is evident that a market news agency of this kind could be operated best by a bureau of the Federal Department of Agriculture or by a corporation under a Federal charter, but in default of such a bureau under Federal auspices, a municipal market department could do the work.

In order to prevent the many disputes which now make trouble between shipper and consignee, the market department should provide for the inspection of any consignment on request, and an official certificate of condition of the goods on arrival.

A wholesale terminal market forms but a link in the chain of coordinated forces necessary for an abundant and cheap supply of food from the planting of the crops to the sale to the consumer; but it is the most important link, because of its influence on both producer and consumer, giving the producer information of the kind and quality of crops to plant, the best methods of packing, grading, and transporting, the kinds and sizes of containers, the supply in the market; while it would be of the greatest help to the consumer, giving him information of the supplies on hand, and influencing the retail trade by advising better methods of buying, storing, and selling. It stands midway

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between producer and consumer, and for that reason is the best point of beginning in the general reform of marketing methods.

Is it not to the interest of all the people of the cities, and therefore a function of the city governments, to see that the way is made clear for these supplies to reach the people without delay, and with as little handling and reselling as possible? No private individual or company has the breadth of power or interest to unify the various conflicting forces for the general public good as has the agency representing all the people of the community.

I would therefore urge upon those concerned in our city governments to take up this subject in the light of modern conditions, study your sources of supply, both near at hand and distant, and the agencies of transportation that reach your gates, and see if a way can not be devised to have the products which your people must have, placed on sale as soon as they reach you, and safeguards incorporated in the system that will make producers confident of fair returns on goods sent to you. Many of the cities of Europe have set us excellent examples, and have planned the distribution of their food supply as carefully as we construct aqueducts for our water supply. Berlin, Munich, Frankfort, and London all have markets at the transportation terminals so that foodstuffs may be sold immediately upon arrival without undue handling. The Halles Centrales of Paris, perhaps the most famous of the European markets, is a large and important center for wholesale dealing, although it is not at the transportation terminals. It has, however, many excellent features which make up for this defect. Practically all these foreign markets have sales at auction, conducted by licensed auctioneers, bonded to the city and forbidden to have any interest in the buying and selling which they conduct, other than the fixed percentage on sales which they collect. Producers desiring to do so may consign their goods to the city, to be sold at the market price by the auctioneers, instead of sending their goods to any of the regular commission dealers. These auction sales act as safety valves on the market—the prices they bring are made public and fix the market prices of the day.

It is, of course, not to be assumed that we can model our markets directly on those of any other countries, where many factors and conditions are necessarily very different. We can learn from their experience, however, where to look for weaknesses in our own systems, and can gain some suggestions as to the lines along which we might improve. It is generally pretty safe to assume that that reform or improvement is most likely to fulfill its purpose which is based on existing economic conditions, and aims to increase the efficiency of existing agencies, rather than to impose new principles and ideas on unwilling business men. In seeking the weak spots we often fail to recognize that we have in many lines developed efficiency in distribution that excites no wonder in us because it is so common. It is a considerable accomplishment to bring oranges and lemons from California to New York and sell them there at retail for two or three cents apiece, and bananas from South America and the West Indies, and sell them for a cent apiece and less, not to mention countless other things.

The terminal market idea is not a new thing—not something heretofore unknown that we desire to impose on the business world. We have in New York to-day a terminal market at practically every railroad freight terminal in the city. What we lack is coordination, marketing space, and supervision. The terminals we have were not planned as markets; they have developed into markets because people have unconsciously realized that the terminal was the place where the primary marketing of foodstuffs could be carried on in the most efficient and expeditious manner, with the result that the bulk of it is car-

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ried on there with amazing efficiency, considering the facilities at hand, and at the same time, because of the inadequacy of those facilities, with enormous congestion, waste, and loss of products.

An extension of the principles of our primary marketing in New York, as now carried on, would give us in the down town section, not scattered terminals, but a large union freight terminal, into which cars from all railroads could be run, with refrigeration, extensive platforms at which trucks could be loaded, and wide spaces in which the traffic might move without congestion, ample storage space, and auction rooms for those desiring that method of sale. This principle, which is advocated for New York City, is no less applicable to other cities of the country where the number of buyers is large enough to prevent combinations to control prices, and this fact is gradually being realized by those who are studying and seeking to improve existing conditions. For example, in the preliminary report of the Chicago Municipal Markets Commission, dated April 1914, this statement is made: "To a certain extent wholesale terminal markets, with modernized equipment, and to which all the railroads in Chicago can make direct shipments of freight, are considered the key to the solution of the problem of the economic distribution of the city's food supply from the railroad terminals to the kitchen of the consumer."

In any city the terminal market, to have the most value, should be not only on one, but in direct connection with as many transportation lines as reach the city, so that freight cars could be switched directly to the market halls, and where goods come by water, so that they could be unloaded from the ships directly into the market buildings. The market buildings should be large enough so that goods need not be held back for lack of room to place them on sale, as sometimes happens now in New York in the heavy seasons. There should be ample storage room and refrigeration to prevent waste through spoilage. The business in a properly planned and located market is bound to grow, and it is better to plan it on an ample scale in the first place than to make extensions later, when buildings have been constructed in the vicinity and property has become high in value. Many of the foreign markets are very large, the Halles Centrales in Paris covering 22 acres, and having cost some $10,000,000. In London Smithfield market covers about 8 acres, Deptford market 30 acres, and Islington (live cattle) 75 acres. Berlin, in the midst of the war, is building a terminal market costing $10,000,000. Food supplies come from all over the world now, so that a wholesale market in a great city assumes the importance of a stock exchange, or cotton or wheat exchange, or other great trading mechanism. For that reason it should be organized so as to handle its business on a large scale with the greatest economy. The time has gone by for hit-or-miss methods of handling the food supplies of a great city.

The salutary influence of proper wholesale markets is not confined to the city, but is perhaps most important in its reaction on production. Wholesale marketing as at present conducted, is a mystery to the average citizen, and a discouragement to the farmer. We will never reduce food prices until we encourage the farmer to produce more, through assuring him of the sale of all he can produce at steady, even though low prices. It is of far more importance to him to be able to sell his whole crop at moderate prices than to sell part at high prices, part at moderate prices and the remainder not at all. In this way only can he put his present fluctuating and hazardous occupation on a business basis. Some years ago I was engaged in an investigation of the reasons for the decline in the value of farm lands in the State of New York and the abandonment of the farms by boys and girls who crowded into the cities. The inquiry brought out many reasons, such as Western competition, loneliness on the farm,

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lack of amusements, and the like, but the most potent reason was that the farm did not pay enough to keep the ambitious American on it. We hear and read continually the advice, "Back to the farm," but such advice is futile unless the farm can be made profitable. A further inquiry as to why it did not pay showed that lack of marketing facilities in the cities added so much cost to the goods before they reached the consumer that the farmer received too low a price for his products, and his business was too hazardous. Conditions have not changed since that time, except for the worse. The city of Munich a few years ago found that the operation there of a modern terminal market, where the farmers of the surrounding country were assured of steady sales at moderate prices, and quick returns of cash for goods consigned to the market, so stimulated production that in one year the market constructed was outgrown by the business it attracted, and needed to be doubled in size.

In the development of our national life a mutual duty exists between the country and the city. The country must produce abundant and cheap food; the city must provide facilities for selling it without loss. It is one of the great problems before the people to-day of national importance.

## THE ECONOMIC TREND IN WHOLESALE METHODS OF FRUIT DISTRIBUTION.

By ARTHUR R. RULE,

*Vice President and General Manager, North American Fruit Exchange, New York City.*

Within recent years the American fruit grower has made an important discovery—a discovery that has broadened his vision and lengthened his perspective. He has discovered—himself—the manufacturer—merchant. To-day he recognizes his orchard as a manufacturing plant, demanding the skill of the scientific expert. He recognizes himself as the merchant upon whose shoulders rests the responsibility of shaping the course of trade channels.

Long-established methods of marketing are undergoing radical readjustment.

### NECESSITY PRODUCED THE MIDDLEMAN, AND NECESSITY ELIMINATES HIM WHEN HE BECOMES UNNECESSARY.

No useful and progressive member of the fruit trade need fear the trend of economy in the process of shortening the distance between the producer and consumer, but he must keep abreast of the times to retain his usefulness to society. Every useless or ineffective method or man must be eliminated, but the scientific horticulturist upon taking possession of a run-down orchard does not necessarily apply the axe or the dynamite stick to remove all the trees. He prunes, sprays, cultivates, top-grafts, fertilizes, and makes a perfect orchard of a former wilderness. Incidentally, there may be a very large brush heap of prunings provided for the fire.

Valuable energy is wasted by some theorists who attempt to suddenly revolutionize existing marketing methods. They fail to give the painstaking investigation so essential to a determination of underlying facts and correct methods. We are apt to occasionally find men who are "sayers rather than doers of the word."

They are not unlike a recent applicant to the Self-Master's Colony, at Elizabeth, N. J. This colony receives recruits from all walks of life, in all stages

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and conditions. To recall them to self-mastery the colony provides various occupations. The applicant referred to had been on a protracted spree. When asked if he would work on the small farm of the colony he declined, as his strength would not permit. He was also unfamiliar with farm work. When asked if he could work in the furniture shop he replied: "No, I can't stand that work; it is too heavy. I can't make furniture anyway." "Could you serve in the art brass shop?" "No, I am not able to do that work; I have never been inside of a brass works." "Could you help with the office work—the bookkeeping, etc.?" "No, I don't know one book from another." "Then, what *can* you do?" "Well, I notice you have devotional meetings for the men here in the evenings, and I think I could work in there. I am hell on *testimony*."

Theory must be wedded to experience; the fruit of such union is progress.

### BENEFITS OF INTELLIGENT, PRACTICAL INVESTIGATION.

Progress and reform require a certain amount of experiment. Opposition from the ultraconservative element is inevitable. In some quarters experimental work is being conducted which may correctly be termed socialistic in its trend. Each of us has perhaps a different conception of the meaning of the term, but the principle of it is an evolution rather than an end. We must remember that water in seeking its level works in and out through various byways, and one unfamiliar with the topography of the land might mistake a backwater basin for the main stream.

Significant of our national development is the wise policy of our Government in the creation of permanent commissions and bureaus to cope with the complex problems of our business and industrial life.

Our Federal Trade Commission, our Bureau of Foreign and Domestic Commerce, and Office of Markets and Rural Organization are typical of the progress we are making as a Nation. Painstaking, practical investigation is made the basis upon which definite progress is made. Truly knowledge is power. May we soon see a tariff commission, and may these several branches of our Government become the means through which a great confidence may be established between our worthy business interests and our National Government. Business must accept its share of responsibility for the suspicions of the past, but the time has come for a new understanding and a clean slate.

We talk of a world market for our immense and increasing crops, and then we drop a tear of sympathy for our Federal Trade Commission, when at the head of a list of questions it has submitted to American exporters we read this inspiring paragraph:

> Irrespective of your opinion as to whether the law does or does not prohibit combinations or cooperative organizations, solely for export business, among American manufacturers or producers by common selling agencies or by other means, please give the reasons why you think such organizations are or are not in the public interest.

If we are to find a world market for our products, we must know what the law does or does not prohibit, and I say Godspeed to the Federal Trade Commission in its investigations.

Our Nation is being referred to commercially as "The Un-United States."

We, of little faith in each other, can never move the mountains that bar our pathway to world-trade development. Exporters of food products to-day do not know where they stand with relation to the law. A Moses of our Department of Justice must come down out of the Sinai of uncertainty and reveal himself to the people.

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Fruit exporters, punished by the blind competition or commercial anarchy of the past, through which some shipments to foreign countries failed to return even the cost of transportation, are seeking a way to cooperate and bring about some stability to the business; but they are afraid of each other, and they are afraid of the uncertainty of the law.

Their plight is not unlike that of the small boy, who, upon being spanked by his mother, retreated under the house. His mother awaited the father's return to bring him out, and when father arrived and proceeded to crawl under the house he was greeted with this exclamation, "Hello, Pop, is she after you, too?"

To emphasize the importance of this phase of our subject it is but necessary to refer to the records of our Bureau of Foreign and Domestic Commerce for statistics showing the hundreds of thousands of packages of apples, citrus fruits, dried fruits, etc., that have been marketed within the past two or three years, regardless of such obstacles as high tariffs, transportation rates, and irregularity of steamship service in the principal cities of South America, South Africa, Australia, and the Orient, to say nothing of the immense quantities of these products which we have for many years been selling in European markets.

If the immense and increasing crops of apples and citrus fruits produced in this country are to return to the producer any reasonable revenue on his investment, it is imperative that the foreign outlet be developed and stabilized. Reasonable combinations among exporters must be permitted; in fact, aided. The investigational work now being conducted by the Department of Agriculture in foreign markets should be prolific of good.

### BUREAU OF BUSINESS EFFICIENCY IS NEEDED.

I submit that under the conservation of natural resources, and with direct application to the fruit business in all its divisions, there is needed a bureau of business efficiency to be operated by our National Government on lines similar to those of other governmental departments which aid the producer.

We conserve our forests, our mines, our latent energy, why not conserve active energy, reduce the waste in the work of the people? It is not a well-adjusted engine that saves in the boiler and wastes at the cylinder. We must seek the leaks.

To illustrate, I have received carefully compiled statistics from the traffic department of one of the most prominent fruit growers' organizations in the United States showing the following figures, which may be considered typical: In the shipping season of 1912, out of a total of 1,375 cars shipped there was collected on 306 overcharges $4,691.05, an average of $3.41 per car shipped, or $15.33 per claim. Complete record was not kept of total number of undercharges, but there were 76 recorded and probably more existed. Records on this season's sales of cars after arrival in the markets show at least 75 per cent of the freight bills incorrect through undercharges or overcharges.

Investigation among the great mass of business corporations and firms will disclose among many of them inefficient systems, costly errors, and wastes. The efficient organizations, through their daily trading intercourse with the inefficient, must carry a large share of the burden; as witness, for instance, the immense detail of checking that is thrown upon the traffic departments of the various shippers to avoid not only freight overcharges but in the case of commission dealers, who must equally protect themselves against undercharges, in view of the fact that the commission dealer is compelled to pay undercharges at any subsequent date regardless of the fact that he may have remitted to his client on the basis of the incorrect bill and may have no recourse against him.

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A few days ago I opened a telegram containing 17 words. I ran my pencil through seven superfluous words which had been conveyed over the wires—an utterly useless burden and expense. There are literally thousands of night-letter telegrams exchanged between cities that have overnight mail service.

To summarize, we need no more graphic illustrations of the need of a bureau of business efficiency than to cast our eyes over the record of commercial failures as compiled by the commercial agencies. Many of these business enterprises might have been saved through a proper cooperation from a bureau of business efficiency. This burden of loss and wasted energy is borne by those efficient concerns that do not fail, and the figures appear in their lists of bad accounts. The bill for all this waste is paid by just two people—the producer and the consumer. There is no way of escape.

Our Interstate Commerce Commission pointed out to our railroads practical ways and means of reducing waste and conserving energy.

The American business man, through his credit association and through other means, has already attempted to do for himself and for his associates a part of this work of bringing all business to a higher plane of efficiency, and the progressive business element of this country would welcome sane, practical cooperation from the Government in the elimination of waste. The machinery of distribution is entitled to as much attention by our Government as the machinery of production. It has been said, "Wise is that man who is aware of the things he does not know."

### THE PRODUCERS' PRIMARY RESPONSIBILITY.

The foundation on which successful fruit marketing is based is that of scientific production and preparation of the product for the market. The salesman can not correct the producer's error.

Growers must organize that they may build and operate packing plants to standardize their products, and cold storages to insure delivery in perfect condition. The Office of Markets and Rural Organization and the various State farm bureaus may further expand and coordinate their efforts in organizing producers.

### WORLD-WIDE DEVELOPMENT AND COOPERATION AMONG PRODUCERS.

Cooperation is now spoken in every civilized tongue. American producers are afire with it. "From everyone according to his ability; to everyone according to his needs," or deserts. This latter idea we see illustrated when the county inspectors enter a grower's orchard and spray or destroy diseased trees at the grower's expense for the protection of the community.

Cooperation is generally accepted as the solution to the producer's problem, but cooperation that stops within the borders of the grower's association or sales organization fails of its full fruition.

If we accept the principle of cooperation at its face value we find that its greatest benefits are obtained through its broadest application; and there is even such a thing as the experienced wholesale fruit handler supplying a community of growers not only with the most expert advice on methods of preparing the product for the market, but we have come to discover that the progressive business element in the wholesale fruit trade freely admits and contributes to the correctness of the principle of cooperation among growers. It is a fact that many, many thousands of dollars have been contributed willingly and freely by progressive men in the wholesale marketing division of the fruit business to organize and educate the grower in improving transportation conditions

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and in other ways. This action need not be credited to purely altruistic motives, but the good effect upon the industry is nevertheless apparent.

In various producing sections we have contrasted in our work the nonprofit organization with the stock company form, each illustrated by some of the oldest and most substantial growers' organizations in this country. In the cooperative organization there is necessarily some political element in the government of the organization's affairs. Changes in management or administration may result through causes other than apply to the strictly business-like conduct of its affairs.

For the stock company form of organization it may be said that with continuity of management and administration there is developed a stability most desirable from a business standpoint. The experience acquired by its officers in handling the affairs of such an organization tends to minimize errors, the cumulative value of experience asserting itself.

Any method of crop marketing that fails to recognize the ground principles of providing machinery through which all markets may be reached is doomed to ultimate failure.

PRACTICAL COOPERATION BETWEEN WIDELY-SCATTERED PRODUCING COMMUNITIES.

The Northwestern apple grower with an active business season of approximately six months is confronted with a serious problem when he attempts to establish a dependable sales representation throughout the markets of the country. He needs the best of talent during the rush of his active marketing season. He needs to be relieved of that expense after the crop is sold. Even though the volume of business crowded into the six months might permit the carrying of the entire force through the idle season until the next crop is ready to harvest, such a plan is extravagant, not only in its expense but the idleness of the salesmen during the no-crop period impairs their usefulness. An unused tool rusts.

The same problem confronts the grape grower of Michigan, the onion grower of Texas, the citrus grower of Florida, and the asparagus grower of South Carolina in a more or less acute form. These producers have been given the pattern of the cooperative growers' organizations of California which they accept as an ideal but they are compelled to cut their pattern to the cloth. Thus various communities of fruit or vegetable growers are individually unable to afford the character of service they desire, but the remedy is so simple it is at once obvious. The principle of cooperation that brings growers together may bring associations together, and that same principle may bring growers' exchanges and large shipping organizations together. For the past five years there has been established just such a central exchange for the use of such organizations.

Working together through this central exchange are found organizations of varied types—purely cooperative, stock-company form, and purely commercial enterprises. Under this plan idleness in the central sales organization through inactive shipping seasons is entirely eliminated. Twelve months' full operation is obtained keeping every unit in daily touch with the buying demand of the country, and a discipline of the highest order is maintained throughout the organization. The producer pays for service only as he uses it; his cost stops the moment his crop is sold; he pays for no idle season, no dull months. Other shippers in other sections with varying seasons provide a continuous business the year round. The highest efficiency and the lowest cost to the producer go hand in hand.

The principle having proven itself sound and efficient in practice, the further extension of the idea embracing larger units of tonnage has been developed

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through the formation of a mutual, nonprofit sales agency handling a volume of approximately 40,000 carloads of perishable fruits and vegetables per annum. This organization I was instrumental in bringing about with others in the year just closed. We thus see a greater expansion and utilization of the cooperative idea than ever before.

### THE CONSUMER THE FOUNDATION OF ALL DEMAND.

The American fruit grower has not lost sight of the fact that he is a merchant, and he is learning the lesson so long and so persistently taught by manufacturers that the consumer must be recognized as the foundation of all demand. When we consider cooperation we naturally recognize the sovereign grower as the master element, but in the final analysis we discover that the consumer is king. His wants must be catered to. The grower with his fine assortment of rare varieties, grown as even the optimistic lithographer of the catalogue never dreamed, brings his fruit to market and puts his product up to the supreme court—the imperial consumer—and he sadly returns home to top graft his trees, to Spitzenbergs, Winesaps, or some other favorite.

With the merchant's instinct the progressive fruit grower does not fully agree with the philosopher who said, in effect, that if you make a better mousetrap, or construct a finer fiddlestick, and live even in Oshkosh, that the world will construct a macadamized highway to your front door. Our merchant fruit grower recognizes the necessity for manufacture of the best of products, and he follows this up not only by delivering the fruit into the world's markets in perfect condition, but he goes to the consumer's front door, enters his library through the medium of the magazine and the daily papers, rides with him in the subway and elevated cars through the medium of color-plate display cards, and insistently impresses the perfection of his product.

Consumers are being educated to discriminate in the selection of varieties, in the multitude of ways in which fruit may be used. The health giving and medicinal qualities are being clearly emphasized. A larger consumption, through the introduction of original packages into the homes, is being largely developed. The consumer's enlightenment is essential if he is to be induced to use larger quantities and greater varieties of fruit.

The opening of this new field for publicity has aroused advertising agencies to offer volumes of advice, and their unfamiliarity with the intricate peculiarities of the highly perishable character of the product has resulted in some amusing ideas being offered.

The experience is not unlike that of Upshaw, the Georgia temperance lecturer, who, while on a lecture tour, stopped with friends in Mobile. The little girl in the family had two very beautiful little kittens. Mr. Upshaw asked their names. She replied, "Tom and Jerry." In shocked surprise Mr. Upshaw said, "Why, my little girl, they are awful names to give such nice kittens. Why don't you call them Cook and Peary?" She replied, "Mr. Upshaw, these are not polecats."

The specialist in fruit advertising is essential. He must closely study the problem of supply and demand in all its sudden and surprising changes—the relation of various competing crop seasons. The bigger fruit advertisers do employ such experts. Campaigns of publicity, both national and local, are being conducted with a marked effect on consumption.

A pioneer movement in systematic advertising of peaches was started while the recent crop was being harvested. In this work the Office of Markets and Rural Organization gave practical and effective aid through an appeal to the retailers of the various large cities to handle larger quantities in original

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packages at smaller profits. The housewives' leagues and women's clubs of the various eastern cities cooperated with the movement through the formation of canning clubs and by widespread publicity appealing to housewives to center their buying during the height of the peach crop movement, basing such advice on the daily telegraphic statistical information furnished by the Office of Markets and Rural Organization.

We are thus brought to the conclusion that cooperation is the trend; that its boundaries are unlimited; that sane, open-minded investigation with publicity create knowledge; that knowledge breeds confidence; that confidence is the foundation of all successful enterprise. We may still employ the first command of all creation, "Let there be light." Then all the forces of the industry will know the truth, and the truth shall make them free in the service of mankind.

## INFLUENCE OF SUPPLY ON PRICES.

By A. U. CHANEY,

*General Manager, American Cranberry Exchange, New York City.*

My experience has been confined largely to the marketing and distribution of fresh fruits, and to these I shall apply my subject.

The price of foods that are considered prime necessities, such as grain, potatoes, meat, eggs, butter, etc., I believe to be less easily influenced by the supply and much less by the weather than of fresh fruits that are considered luxuries, such as strawberries, peaches, pineapples, cranberries, apples, grapefruit, oranges, etc. We must concede that the market price of any article is determined by the law of supply and demand. The demand, I believe, affects the price on fresh fruits more quickly than the supply. Then let us first discuss what influences the demand.

The demand for fresh fruits is influenced by weather conditions, quality, and appearance, packing, container, advertising, stability of market, and the price.

The weather is often a greater factor than the price in creating or retarding the demand to an abnormal degree. For example, lemons, cantaloupes, strawberries, etc., are in greater demand when the weather is hot; whereas, apples, cranberries, sweet potatoes, cabbage, etc., enjoy the greatest demand in cool weather. Ask almost any market expert to hazard an opinion as to the probable market price of fresh fruits even as much as one week ahead and he usually prefaces his answer by providing for weather conditions. The United States Weather Bureau is of invaluable assistance to marketing men by the issuing of dependable weather predictions a few days in advance. I hope the time is not far distant when the Weather Bureau will be able to look farther into the future and give us reliable predictions two weeks in advance. In determining the proper price for future deliveries normal weather conditions only should be considered.

The quality and appearance of fresh fruit more easily influences the desire of the consumer than the price. The desire seems to be more easily created by sight than by taste. Quality and packing of fresh fruit is of such importance that proper standards of quality or grading of all varieties of fruit and produce should be established, either by the Government or by growers or trade organizations. Producers everywhere should be educated to the supreme importance

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of quality and appearance. Fruit should be picked in prime condition, and it should be stored and packed so that it will reach the consumer while it is attractive and sound.

Good packing influences the demand decidedly. The highest quality of fruit often has a large per cent of its value wasted by careless, improper packing, even though packed in proper packages. Much of the trouble is caused by lack of knowledge of how to pack properly. Especially is this true among small growers. Much of it is caused by growers' inability to secure experienced, trained packers. This is especially true in new producing districts. Some of the poor packing is caused by the lack of appreciation of the producer as to its importance, and coupled with this is his desire to pack cheaply, and such an offender usually disregards advice until he has tried out all markets and various sales agents in an effort to get full price for cheaper packing. To some degree every shipment of poorly packed fruit reduces the value of all receipts of similar fruit in the market that it reaches.

The container should be such as will best insure the safe transportation of its contents, be of convenient size, and be neat and clean in appearance, and when opened it should so display its contents as to attract the consumer's attention. The necessity of national standardization of containers is constantly growing in importance. Standards of measure greatly vary in different States and communities. Shipments of the same commodity may reach a market like New York City on the same day from many different States, packed in almost as many different styles or sizes of containers, according to the custom or State laws. Under such chaotic conditions proper prices can hardly be determined and unnecessary annoyance and waste of values is the natural result. The last United States Congress, influenced by the urgent solicitation of the United States Bureau of Weights and Measures and various growers and trade associations, enacted a national mandatory barrel law, giving us a standard barrel for all fruits and vegetables. I trust this is the forerunner of a national standard container for all fresh fruits.

The advertising feature affecting demand is of more importance than many producers and dealers appreciate. The seasons for some of our very best fruits are short, and often they are half over before a large part of the consuming public knows or realizes what fruits are "in season." A great many retail dealers fail to buy or display a variety of fruit until they begin to have call for it from the consumer. Often this is the sole cause of slack demand and abnormally low prices during the first part of the season. By advertising at the proper time in ways that will attract the notice of retailers and consumers the demand is greatly increased.

The stability of market, when possible to secure it, I believe goes further toward encouraging the jobber and retailer to push sales and take special interest in a fresh product than anything else. It is my observation that the consumption of fresh fruit, perhaps more than anything else, increases according to the degree the sale is pushed. The rapidly increasing crops of fruits makes it imperative that a demand be created that is far beyond the natural call. There is a vast difference between the sale of fruit which the dealer simply has for sale for those who come to inquire for it than there is for the fruit which the jobbers must dispose of by sending out salesmen to solicit orders from retailers, because in addition the salesman must inform the retailer as to what is in the market and what is due to arrive soon, and whether the retailer's clerks in turn should solicit the consumers' consideration. The jobber and retailer are the natural acting salesmen for the producer, and on these salesmen's efforts the growers' interest depends. They are the necessary connecting links between the producer and consumer. The interest they take in pushing the sale of fresh

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fruits is naturally influenced by the certainty of their remuneration. The smallest liability to loss and the greatest certainty of a moderate profit interest them more quickly and certainly than the possibility of large profits, coupled with the danger of serious losses. They are in the position of a certain United States Congressman who had been a leading attorney in his home district. A friend asked him how he could afford to give up his law practice for a Congressman's salary. He answered: "The salary is almighty regular." Dealers are often severely criticized for charging seemingly exorbitant profits on fresh fruits. The frequency of violently fluctuating values, heavy shrinkages, causing such a large per cent of loss, makes margins which appear unreasonable necessary.

Large corporations or organizations and close cooperation among both growers and jobbers in order to regulate the supply and distribution so that all fresh fruit and produce may reach the consumer while in prime, palatable and attractive condition, giving the consumer true value, instead of wasty, decayed and an unsatisfactory food, would tend to establish this market stability, broaden distribution, increase the interest of dealers, greatly increase consumption, and reduce the present necessary margin of profit or cost between producer and consumer more than any other system. One salesman for a large jobbing house distributing a full line of fruit and produce could easily visit 30 city retail dealers in a single day and fully inform each of the 30 concerning all fruits and produce in the market and due to arrive. Moreover, he could take orders from each of the 30 for delivery on the following day. One to three trucks could make deliveries to the whole 30 on a single trip. To-day in our large market centers each of these 30 retailers must go to the market and send or take his truck and secure and haul his own supplies for the day. This system takes the valuable time of the 30 retailers from their stores and 30 trucks to do the work that one salesman and from one to three trucks could do better. Mr. Retailer can, if he wishes, and often does, buy his supply from second-hand dealers, from what is known as a wagon peddler, who has bought a load of truck on the market and peddles it out to retail dealers for such profit as he can command. Such retailers must be content to have "on sale" the limited assortment which he can secure from the peddler wagon. To economize time Mr. Retailer, who goes to the market often, makes two trips a week and plans to buy a sufficient supply to last until the next regular trip, thus causing what is known as the "big days" on a market. Naturally, such a system does not insure a full daily supply of strictly fresh stocks in the retail places. Much of the fruit is shipped from the producing point to what are known as "receivers" in our large centers and then sold by the receivers through independent auctions to jobbers and then by the jobber it is sold to either the retailer who comes to the market and buys and takes away his supplies, or to the wagon peddlers, who in turn sell to the retailers, who in turn sell to the consumers. How much more simple and economical in time, expense, profits, and how much less deterioration would take place if the fruit or produce could be shipped to large jobbing houses in the first instance and by them sold and delivered direct to retail dealers.

Right here is where I believe the present system of marketing in great centers is out of date and economically wrong. I believe the auction system is our greatest disturber of market stability and does little to encourage trade or consumption. Indeed, more modern methods should be fostered. The fruit-growing industry has increased in a few years to enormous proportions, but marketing and distributing facilities have not kept pace with this growth, so the industry is suffering great waste and loss for lack of proper marketing equip-

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ment. Because of the perishable nature of fruit and because the industry has been considered a peddler's job the large capitalists have not been attracted to it as they have to meat, grain, etc. This, I believe, is what the industry is in great need of and should be encouraged.

The price is perhaps the last but not the least item to consider in influencing demand. The desire for our fruits must first exist in the mind of the consumer, and then the price must be within his means to insure his purchase, and it must be in proper relation to values of competitive foods. The question of the high or low price of food is a psychological one, and the haphazard, random statements frequently appearing in the newspapers and magazines that, at best, deal only in generalities and seldom touch the facts as applied to fruits, is one of the factors in destroying demand, because the consumer assumes through repeated reading that a commodity is high when in reality it is low. There is, however, always a high point in values, where, if it is reached, the consuming masses will turn to substitutes and a later reduction in price will seldom bring back the consumers' favor during that season. Marketing men generally understand the serious danger of a high price diverting consumption away from their product. For example, during the cranberry season of 1912 I addressed the following query to 200 retail dealers throughout the United States: "Supposing the retail price of cranberries is 8½ cents per quart, or 3 quarts for 25 cents—please state what reduction in your sales would result from advancing the price to 10 cents per quart, 12½ cents per quart, 15 cents, and 25 cents." I received 92 replies and from 20 different markets located in 16 different States. The average of these replies showed that the estimated percentage of decrease of sales as price advanced was as follows:

Advance from 8½ cents to 10 cents per quart reduce sales 12 per cent.

Advance from 10 cents to 12½ cents per quart reduce sales 23 per cent.

Advance from 12½ cents to 15 cents per quart reduce sales 37 per cent.

Advance from 15 cents to 20 cents per quart reduce sales 67 per cent.

This same inquiry was made by the Hon. John A. Gaynor, of Grand Rapids, Wis., a prominent cranberry grower, to 100 retailers in the State of Wisconsin in 1906, with the following result: Advance from 10 cents to 12½ cents per quart reduced sales 49 per cent; advance from 12½ cents to 15 cents per quart reduced sales 74 per cent.

The difference between Mr. Gaynor's figures of 1906 and my own of 1912 may be because of increased regular cranberry consumers in the later year, or by the difference in the purchasing power of the dollar.

The supply is not appreciably affected by price, except as prices reach abnormally high levels and draw supplies from remote sections, or by abnormally low prices diverting away from a given market supplies intended for it, retarding shipments or preventing shipments altogether by the price being below the cost of packing, transportation, and marketing expenses. A decreased supply is less likely to cause an advance than an increased supply will cause a decline. The price may be so adversely affected by the supply of fresh fruit and vegetables being thrown on the market in excess of the demand, that, in order to secure and insure any stability of price, the control, or partial control, of the supply seems absolutely necessary, and so necessary that I believe the Government should recognize its necessity and extend to agencies marketing for the growers the same latitude extended to the growers themselves in the way of permitting and encouraging their organization for exchange of information and control and regulation of distribution. Most of our fruits and produce can not be held long in prime condition, even in the best of cold storages. They must be sold while in prime condition and can not be held for ransom. Thus monopolies on fruits are an impossibility because

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of the very nature of the goods. Moreover, policies of conservation are necessary if the producer is to reap any reward for his labor and if the consumer is to have a fresh, fine article at a stable, reasonable value without fluctuations which destroy or adversely influence the demand. The control of the supply should be legitimate and only sufficient to maintain the demand relatively to the crop produced. The business of trading in fresh fruits and vegetables is probably the only one in which supply and demand entirely control values.

There is always a low point reached, in case of an oversupplied market, where no lower price will increase the sale. The consuming masses under any marketing system now in vogue in large centers can not be made to respond with sufficient demand to relieve a glutted market before the fruit or produce has so deteriorated as to be unattractive to most of the consumers, if not unfit for food. This fact explains the reports of carloads of fruit or produce which are being dumped while price in uptown retail stores is but slightly changed. The commission merchants or receivers must bear the burden of unjust criticism. Price of fresh fruit can be so low, caused by excessive supply, that there is no room for profitable margins to commission merchants, jobbers, or dealers; hence the trade will not use much effort to sell them and will bend all their energy to sell other things in which there is a profit. From this cause often rises the statement that when prices are high more fruits sell than when they are low. Last summer potatoes were cheap and netted a price to many growers below the cost of production. I heard more than one dealer and grower remark that people did not seem to eat many potatoes when they were so cheap.

Marketing men, I am sure, will agree that a large supply under proper control can be distributed to the markets of the country at much better prices to the producers and at perhaps as low cost to the consumer and to greater satisfaction and more certain profit to the dealers than a smaller supply uncontrolled or unguided. A very great deal of waste and heavy losses constantly occur by shipments being sent at random, totally without regard to the demands of such market for that variety or grade. Markets greatly vary in their demands for character, variety, color of fruits, according to the customs of the people and tastes previously acquired and this knowledge is of vital importance in supplying their requirements.

Supplies are often forced on the markets unduly by the necessity of getting money for the producers to pay picking and other expenses. The difficulty growers have in borrowing money from their home banks has much to do with this. Some kind of Government aid in this direction might be of good service.

The season for many of our fruits begins with light shipments and the supply for the first few days, which is unequal to the demand for the first arrivals, causes abnormally high prices being paid for the first deliveries, and this act establishes the price at retail on too high a level. The retail dealer, because of his custom to have a uniform average price, instead of changing his price from day to day as the wholesale market fluctuates, is slow to reduce his opening price, and thus the high price fixed by the first small shipments retards the free consumption that the heavy supply in the midst of the season greatly needs. When a commodity is under at least partial control all efforts should be made by competent authority to determine the right price in proportion to the season's total production and maximum consumption, which will distribute the whole crop over the whole marketing season, and which will insure, so far as is possible, stability in market conditions, making it safe for dealers to operate freely on reasonable margins of profit, and furnish consumers with prime fruit at reasonable prices. The wrong price results in fluctuations in supply and demand which cause the consumer to pay excessive prices for good



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fruit in times of scarcity, or frequently to receive stale, unpalatable fruit at prices out of proportion to the ruinously low prices obtaining in wholesale markets in times of glut. Such a price would yield maximum returns to the producers as a whole; so any price above or below that right price lessens the money received and injures the grower, the legitimate dealer and the consumer. The loss caused by a too low or a too high price is in wasted effort and by wasted or deteriorated material. The Government and producers' and dealers' associations should more and more foster such a control as will restrain early shipments of fruit until it is of sufficient maturity to be good food and then render all aid possible in determining proper values being established. It is safer and more beneficial to all in the end to start the price too low rather than to endanger an ample demand by placing the price too high at the start.

SUMMARY.

The influence of supply on prices is dependent upon the natural and artificially created demand, upon the control, or lack of control, of the supply, and the facilities for and manner of the distribution.

The natural demand is mostly influenced by weather conditions and the quality and appearance of the fruit, and the artificial demand is created mainly by the efforts, good will and energy of the middlemen or salesmen, by advertising and by the price.

The facilities and equipment for distribution should be such as will deliver the fruit from the producer to the consumer with the least delay and least handling and rehandling that can be made practical.

The present average yearly production of fruits is so near the present maximum consumption under existing marketing methods as to seriously endanger the possibility of marketing the whole output at prices profitable to the producers, and serious consideration should be given to all possible improved and economical methods of marketing.

Jobbers having a very large capital are needed to facilitate most economical distribution in our large cities. National standardization of weights and containers should be established. Close cooperative control of supply and regulation of distribution should be permitted and fostered by the Government to lessen the risks of dealing in fresh fruits and vegetables and to aid in establishing stability of values.

## THE ECONOMIC VALUE OF THE AUCTION AS A DISTRIBUTOR OF PERISHABLE COMMODITIES.

By VICTOR K. McELHENY, Jr.,

*President American Fruit and Produce Auction Association, 204 Franklin Street, New York City.*

### I. PUBLIC ATTENTION CENTERED ON THE AUCTION SYSTEM.

In recent years a tremendous impulse has been given, in all lines of business, to the adoption of efficient methods. Growers and shippers have made great strides in growing, packing, and securing good transportation facilities. Crops and the population are increasing. The problem is so to increase distribution and consumption as to market these crops satisfactorily. This important marketing problem has centered attention upon the "auction" or "public sale" system as a distributor of fruits and vegetables.

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II. PREJUDICE AGAINST THE AUCTION.

Whenever the word "auction" has appeared it has suggested to some a red flag—a man standing on a counter or chair yelling at the top of his voice and knocking down under the hammer whatever by way of rubbish happened to be at hand. With regard to the auction sales of fruit as conducted by the large auction companies the picture is so entirely different that it is hard to make a comparison.

III. HISTORY OF THE INDUSTRY.

***In the foreign markets.***—In England, France, and Germany, auction sales of fruit and vegetables are tremendously and increasingly important. Examples of their importance in the three leading markets of England and in the port of Hamburg will suffice. England's over-sea importation of fruit and vegetables is vastly in excess of its home production. Auction has been in practice there for 100 years. In the four important foreign markets named the offerings at auction are as follows:

Glasgow: Ninety per cent of all fruits; nearly all flowers and plants; foreign vegetables, principally from Holland.

Hamburg: All foreign fruits and produce.

Liverpool: Apples from America, Canada, Australia, Tasmania, and Spain; oranges from Jaffa, Italy, and Spain; melons, tomatoes, and potatoes from Spain, and onions from Egypt and Spain; Almeria and Lisbon grapes, etc.

London: Eighty per cent of all foreign fruits and vegetables. The importance of auction in England will be emphasized when it is stated that in the year ending May 1, 1915, there were imported into Liverpool, London, and Glasgow about 1,788,236 barrels and 1,096,054 boxes of American and Canadian apples, nearly all of which were sold at public auction.

*In the United States.*—In the United States auction sales of fruits began about the year 1847 and have had a wonderful and sound growth ever since. The circumstances under which auction was inaugurated in the various fruit industries which now use this method have been strikingly alike from the beginning until the present; and these same circumstances now confront certain industries which have not yet turned to auction.

In the early days almost all oranges, lemons, grapes, and pineapples were imported from foreign lands. Large quantities would arrive at our Eastern ports consigned to various importers; buyers were divided and had to trade with various importers in various quarters. There was no uniformity or stability of price. Similar grades would bring widely divergent prices. Some brands would sell well; the same quality bearing a different brand would be sacrificed. Commodities could not be quickly distributed. Distribution was not expanding with increasing offerings. Before a cargo was cleaned up at private sale, another cargo would arrive. Neither shipper nor buyer knew what he was doing. It was not merchandising; it was speculation. Such obstacles restrain trade instead of expanding it. For the purpose of overcoming this division of the trade, of concentrating sellers and buyers in one place, of giving stability and uniformity to prices, and of securing speedy and wide distribution auction was adopted.

To-day there are 16 American cities in which are held regularly public auctions of fruits and in some instances vegetables.

To-day 85 per cent of Florida oranges and grapefruit; 75 per cent of pineapples, oranges, and grapefruit from Porto Rico, Cuba, and Isle of Pines; 98 per cent of California oranges, lemons, cherries, peaches, apricots, pears, plums, and prunes; 100 per cent of Sicilian lemons; 100 per cent of Almeria grapes from Spain; 100 per cent of cherries, pears, and prunes from the Pacific north-

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west, which are sold in the large auction cities of the eastern part of the United States, are now sold at auction. In addition, the bananas that are consumed in New York and Baltimore are sold in that way. In 1914 $150,000 worth of chestnuts from France, Spain, and Italy added to the vast volume of business going through the auction companies of New York.

### IV. SERVICE RENDERED BY THE AUCTION.

*Advertisement.*—The auction advertises the sale in a daily paper, describes the offering by brands, gives the day and hour and place of sale. In order to attract as many buyers as possible the auction endeavors to advertise in one sale a variety of commodities.

*Catalogue.*—The offering having been divided into units attractive to buyers a catalogue is printed. Each page of the catalogue has up to 17 lines on it, each line representing one of these units. Each line is marked with a number in definite order and each line gives the size of the commodity in each package, the brand, the name of the grower, when the car is made up of shipments from various growers, and the number of packages. In the case of domestic commodities the catalogue also contains the name of the shipper, the car number, whether the car is refrigerated or ventilated, and the name of the shipper's agent. In the case of imported fruit the name of the vessel is given and the landing pier. A copy of one page of a catalogue with prices realized is given below.

| Lines. | Marks. | Description. | |
|---|---|---|---|
| | | PORTO RICO FRUIT EXCHANGE. | |
| | [Bayamon Fruit Growers' Association, Bayamon, P. R.] | 88. Brazos. | |
| | Fancy: | Fancy Porto Rico grapefruit. | |
| 1387 | 36 | 2 boxes | $4.00 |
| 1388 | 46 | 11 | 5.87½ |
| 1389 | 54 | 72 | 5.00 |
| 1390 | 64 | 90 | 5.00 |
| 1391 | 80 | 91 | 5.00 |
| 1392 | 96 | 29 | 4.50 |
| 1393 | 112 | 4 | 3.62½ |
| 1394 | 126 | 19 | 3.25 |
| | [Villa de Leon, Bayamon, P. R.] | | |
| | Fancy: | | |
| 1395 | 46 | 2 | 3.37½ |
| 1396 | 36-46-1 100-1 | 2 | 2.50 |
| | Brights: | | |
| 1397 | 46-2 54-7 | 9 | 3.37½ |
| 1398 | 64-17 80-2 | 19 | 3.75 |
| 1399 | 100-7 126-1 | 8 | 3.12½ |

The above is taken from a catalogue of an auction sale of Porto Rico grapefruit held in New York City on October 26, 1915. The first column on the left contains the line numbers; at the top of the second column is the "cut" of the brand; below the cut in the same column is the grade of fruit, "Fancy"; below that in the same column and directly to the right of the line number is the number of grapefruit in each box. For example, in line 1387 the figures "36" mean the boxes contain 36 grapefruit; in the third column is the number of boxes in the line (in the case of line 1387, two boxes), and in the fourth column the price realized at the sale for each box of grapefruit in the line.

*Lining up of the offering.*—The contents of the car or the cargo is divided into units exactly as called for by the lines of the catalogue. That is called "lining up." These units are marked with numbers to correspond with the line numbers on the catalogue. This "lining up" is done so that the buyer can quickly examine the fruit or other commodity and make a notation as to its quality and condition on his catalogue as an aid to his bidding at the sale. Also the "lining up" aids a speedy delivery of the commodity after the sale.

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*Parts of marks.*—The auction also opens a certain number of packages of each "line" offered for sale for the inspection of the buyers. These are called "parts of marks" not "samples." The buyer has the privilege himself to open for his own inspection other packages of the line if he desires.

*Sale.*—The commodity is sold at public action to the highest bidder by auctioneers who are specialists in the line of goods that they sell.

*Record.*—At each sale the auction clerk makes a record of the number of the lines sold, the price at which the goods are sold, the name of the buyer and the quantity purchased by each buyer. This record is open to the inspection of the seller.

*Delivery.*—The auction superintends the delivery of the commodity sold to the buyer.

*Discount.*—Within 24 hours of the sale the auction sends an "account sales" to the seller, together with a check for the amount of the sale less the commission charged by the auction house. Ninety per cent of the auction sales in the large auction markets are on credit.

*Guarantee.*—The auction house guarantees the seller against loss arising from the insolvency of the buyers.

*Price-realized catalogue.*—The auction house after the sale furnishes the seller with an exact copy of the catalogue used on the sale with the prices realized opposite each line sold. (See catalogue on p. 742.)

### V. THE SELLER AND THE BUYER AT AUCTION.

In order to understand intelligently the position of the auction in the channel of distribution between the producer and the consumer it is necessary to understand who it is that supplies the auction with the commodity to be sold and who it is that purchases. A diagram on page 744 sets forth the position of the auction in the channel of distribution.

*The seller.*—In most of the markets where auctions are established the auction house does not accept direct consignments. Auction offerings come through the salaried representatives of cooperative associations, the salaried agents of shipping concerns which assemble growers' shipments into carload lots or through private agents of growers, which latter are termed "receivers" and who work on a commission basis. These receivers usually handle only commodities sold through the auction. Other offerings come through "commission men," who sell at auction commodities customarily thus sold, while selling their other commodities at private sale.

*The buyer.*—There are present at the auction sales jobbers, fine fruiterers, wholesale grocers, representatives of chain stores, brokers for hotels, restaurants and retail stores, pushcart men, and peddlers. There are buyers for all grades of fruit from the very finest to the most inferior. There are buyers for fruit in prime condition and buyers for ripe fruit that must go into immediate consumption. There are large buyers and small buyers.

### VI. DISTINCTIVE CHARACTERISTICS OF AUCTION.

*Complete publicity.*—The literature of distribution is full of complaints that necessarily arise where there is not the opportunity for the grower or shipper to see for himself all the details of how his shipments are sold and the prices realized. One of the most important features of the auction is that it works in the plain view of all. It eliminates at once all these complaints. The larger the quantity of a commodity the greater the necessity for complete publicity on distribution. Auction gives that publicity. Auctions are public sales in every sense of the word. The auction houses can have no secrets. Any questions that may be asked of them by a shipper can be answered and will be answered.

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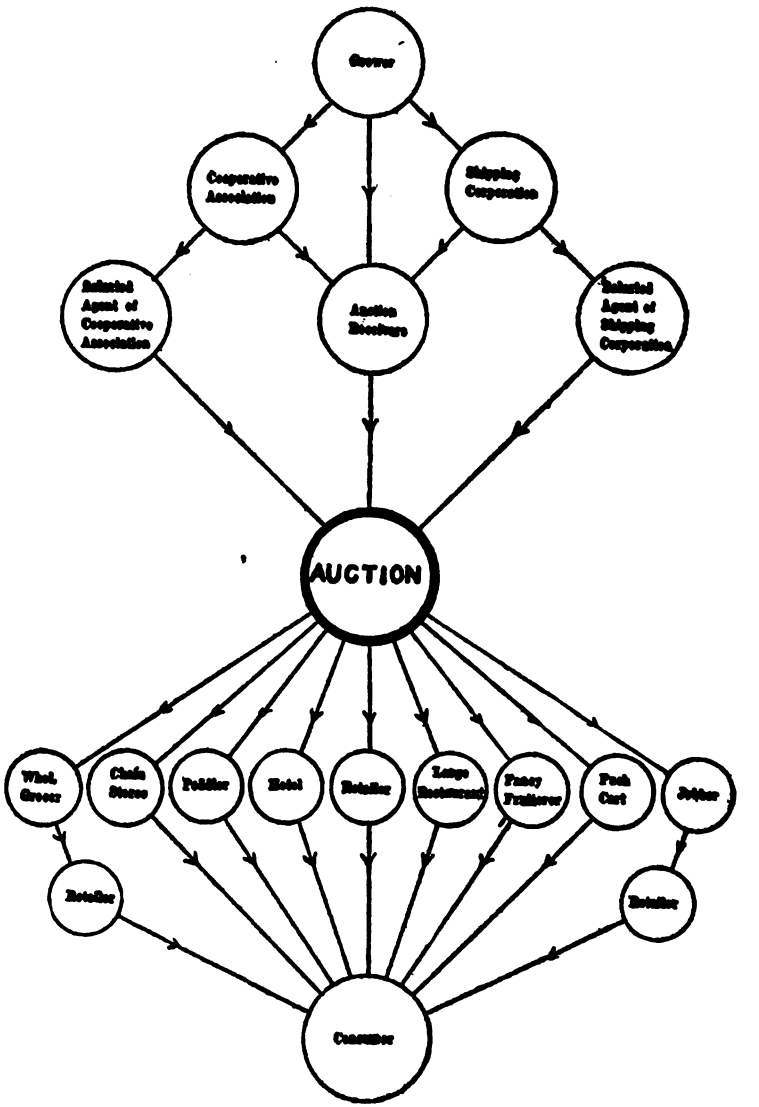
*Open competitive bidding.*—Not less important than complete publicity is competitive bidding; in fact it might be said that the keystone of the auction system is the selling of the commodity to the buyer who will bid the most after open competitive bidding. The experienced auctioneer knows the buyers, knows what buyers are dealing in the same lines of fruit and the inevitable result is that




POSITION OF AUCTION IN CHANNEL OF DISTRIBUTION

competitive bidding brings to the grower results that can not otherwise be obtained.

*Auctioneer.*—No system of selling can handle the vast quantity of goods that the auction sells with as few salesmen. The auctioneers are the salesmen. They must be efficient. It takes years to make a successful auctioneer in these lines. The auctioneer must know and be a specialist in the fruit or produce business.

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CALIFORNIA ORANGES AND LEMONS SOLD AT AUCTION ON ERIE RAILROAD PIER 20, NORTH RIVER, NEW YORK CITY.

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DISPLAY OF "PARTS OF MARKS" (SAMPLES) OF FLORIDA AND PORTO RICO FRUIT IN THE AUCTION COMPANIES' DISPLAY ROOMS IN THE FRUIT TRADE BUILDING, 204 FRANKLIN STREET, NEW YORK CITY.

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His duties require him just previous to the sale to examine the commodity that he is to sell as to quality and condition and make a notation on his catalogue so he can secure the highest price for the different grades of fruit. He also must know the quality and condititon of the commodity sold by his competitor. The auctioneer pays a license fee and is under bond to the municipality.

*Minimum expense.*—There are few points connected with the marketing of fruit and produce that equal in importance the matter of expense. It is, therefore, well to remember that the auction system of selling enables the grower to get prompt returns from the auction companies at a lower selling expense than by any other system.

VII. CONTRAST OF PRIVATE SALE WITH AUCTION.

A forcible way of bringing the auction system concretely to the mind is that of comparison. There is no desire on my part unnecessarily to disparage other methods. Private sale performs its service and has its place in efficient distribution but I desire to fix clearly in the mind of the hearer the important function performed by the auction.

*Private sale way.*—Picture a large industry, for example, the New York State barreled apple, the Northwestern boxed apple, the cantaloupe, watermelon, or peach industry, or in fact any line of fruit or vegetables where the production has become large, divided into small scattered selling units rather than concentrated in one place. Picture the buyers scattered. Picture two men negotiating over the price. At private sale a number of buyers never negotiate at one time. If any man sees another negotiating he will wait on the corner until the deal is completed and then take his turn. That consumes time and I might in this place point out that all loss of time means in the end an economic waste. The seller endeavors to get as high a price as the drift of the market will stand. He is handicapped by the fact that he must keep in mind retaining the buyer's patronage. The seller is often further handicapped by not knowing what supplies his competitors are offering. The seller has undesirable sizes and grades of fruit which the buyer does not want but which the seller is inducing the buyer to take by offering the desirable fruit for less money. The buyer is trying to obtain the fruit at as low a price as he can. No public record is kept of the price for which the goods sold. Furthermore it frequently happens that a large shipping concern will employ one-half dozen commission merchants in a large market. A buyer must necessarily go to several of these houses before purchasing in order to determine the market. Time is wasted. Again let me say that waste of time by buyers must mean in the end a loss to growers.

After viewing this mental picture, then compare the auction sales in the auction room and you will gain the viewpoint of the progressive grower of California and Florida.

*Auction way.*—Picture all the commodity and all the buyers concentrated in one place at one time. The buyers arrive in time to inspect the commodity that is on display in one large warehouse or on the railroad pier. In that large exhibit each buyer—whether the fine fruiterer or the broker for department stores, or the chain store, or the retail grocery, or the pushcart man finds the lots and grades that he wants—in fact that he must have, if he is to keep his customers from going next door after their fruit. At a given time the gong rings and the buyers assemble in the sales auditorium. As a winning bidder needs to take only a limted number of boxes the representatives of the largest jobbing house, or department store, or grocery house, or chain store, or hotel, or large restaurant in town who needs 200 boxes of a certain grade of fruit must bid against a buyer who wants but a limited quantity. The buyer must

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be aggressive in order to secure what he wants. With this free working of the law of supply and demand the price is fixed. Many a buyer goes to the auction with the idea of buying but 50 boxes and goes away the purchaser of 100. He sees what he thinks he can make money on and buys. The next hour, he, and all of his firm, are at work trying to sell the fruit he has bought. Buyers prefer the auction method because the sales are public. They then know what their competitors are paying and are on an equality with them. Auction saves the buyers time. That means increased purchasing power for "time is money" and the grower benefits.

Finally, every auction sale is a matter of public record. The catalogue and sales sheet are kept for a certain period before their destruction is permitted. Some of the auction companies keep their papers for years. The shipper can write to the auction company and get a mailing catalogue showing the correct prices. In the city of New York, for example, the Daily Fruit Reporter, an independent paper, publishes each day the results of the sales, car by car, and brand by brand. Any grower may sit in the public sales auditorium and hear the auctioneer sell his commodity to the highest bidder at a certain figure. He may note on a catalogue what his fruit or vegetables sold for and then compare that with the "account sales" subsequently rendered by the auction company. He will find that they agree completely.

### VIII. IMPORTANT RESULTS ACHIEVED BY AUCTION.

*Relief of a glutted market.*—The auction can relieve a glutted market as no other medium can. Just as soon as the market sags the representatives of the peddlers and the pushcart men at the auction buy heavily. With all the pushcarts and peddler's wagons featuring a commodity, many not handling anything else for the time being, vast quantities of fruit can be disposed of in case of a glut. The result is that consumption is greatly increased. The glut relieved, prices rebound and the market becomes normal.

The public sales system has a particular advantage over private selling in that, the glut having been relieved, the stimulated rate of consumption sends prices upward at once. It is quickly apparent that a number of buyers want a certain kind of fruit. No buyer can hide the fact. He must bid briskly and bid high if he is to get the fruit that his customers want.

*Full market value when the crop is short.*—The objection is often made by the opponents of the auction that this method does not secure as high prices as private sale when the crop is short. That is contrary to the facts, and as an illustration note the following: Apples are a short crop this year. At the auction sale of New York State barreled apples held in the orchards of certain growers at Red Hook, N. Y., Gardiner, N. Y., and Syracuse, N. Y., on September 1, 2, and 8 of this year, notwithstanding the inauguration of a new system and in the face of strong opposition these results were secured: It was a matter of common knowledge that previous to the auction sales buyers were paying farmers $2.50 per barrel for grade A, declining in all cases to buy grade B fruit, and in a very few instances for some high-class fruit $2.75 per barrel was paid for grade A fruit. At the auction sales the lowest price paid for grade A was $2.70 per barrel and the highest price was $3.40. In most cases the price paid was from $2.80 to $3.40 per barrel for grade A. Grades A and B in one orchard were sold together for $3.40 per barrel. Grade A and grade B apples together of another orchard sold for $3 per barrel, and grade A and grade B apples together of three other orchards were sold for $2.85 per barrel and $2.75 per barrel, respectively.

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*Full market value for both high class and inferior grades.*—A relic of ignorance and prejudice on the subject of public sale as a means of distribution is the feeling held by some of the less informed that the auction might sacrifice high-class fruit. Nothing could be further from the facts. There are present at each sale the fine fruiterers, high-class grocery houses, brokers representing high-class hotels, restaurants, and retail houses and jobbers who specialize in high-grade fruits, all interested in high-class fruit only. The result is that these fruits are bid up to the highest price that the market will warrant. In fact prices are realized at times for high grades of oranges, grapefruit, Spanish grapes, lemons, pears, California grapes, plums, and cherries sold at auction that could be secured in no other way. Furthermore, the auction is the keenest discriminator between the fruit of the careful grower and packer and that of the careless. Every grower and packer who uses intelligence, time, and care in the production and packing of his fruit wants these elements recognized. No system equals the auction in recognizing what is good and in paying for it accordingly. The auction is the place above all where each grower's effort stands on its own merit.

*Stability of price insured.*—There are no wild fluctuations in the prices at auction. The fruit and the buyers are all in one place, and the law of supply and demand is not interfered with. The fruit auctions are held regularly and every day (Saturday excepted), in the large cities at a regular scheduled time. The buyers who attend these sales make a regular business of buying and selling fruit. All of the buyers speculate occasionally, but the great bulk of their buying is to supply a present need.

*Speed in delivery.*—One great essential in marketing fruits and vegetables is promptness in the delivery to the buyer. This promptness is essential where large quantities are handled. The auction specializes in promptness of delivery. For example, 100 cars of California fruit—in addition to the other lines of different varieties selling—are sold and delivered in a single day without overtaxing the capacity of the auction to deliver promptly in one of our large cities. The more prompt the delivery the more satisfaction to the buyer and the more he will pay.

*No changing of price after sale.*—At private sale if a buyer finds that he has paid more than his competitor, he goes back to the private seller and asks him to cut down the price to what his competitor paid. The private seller does this to hold his trade. At auction the price stands and admits of no reduction.

*Equality of large and small growers.*—At the auction the only inequality is that of the quality and condition of the commodity offered. No seller receives more money because he is a large and influential grower, and no grower receives less because his offering is modest. Each man's fruit sells on its merit. It is not the man that the buyer has in mind when he bids, but the quality and condition of the commodity.

*Widening of distribution.*—A recent concrete example of the way auction sale of fruit increases the number of buyers and thereby widens distribution is the sale of bananas at public auction in the cities of New York and Baltimore. The company importing the largest amount of bananas changed from private sale to public sale in New York City April, 1913, and in Baltimore July 1, 1914, with the result that the number of buyers increased nearly tenfold. It has happened that in a single year in some auction cities sales of California deciduous fruits have increased 30 per cent, and in a period of five years 100 per cent when California had a heavy crop; and the auction has been sufficiently flexible to take care of and distribute the increased crop. Similarly sales at auction of Florida oranges in Boston have in a period of five years increased 200 per cent.

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Now, compare the foregoing with the consumption of Northwestern boxed apples in Boston under private sale: Season 1911–12, 370 cars; 1912–13, 365 cars; 1913–14, 354 cars; 1914–15, 360 cars.

The result is that although the crop of Northwestern boxed apples has increased greatly private sale has not been sufficiently flexible to widen distribution. The large number of buyers that deal exclusively in commodities sold at auction being assured of a source of supply at auction would welcome the opportunity to add other commodities to the list already dealt in. In addition, buyers who deal in commodities not sold at auction would follow those commodities into the auction.

*Combinations of buyers impossible.*—There are too many racial differences and too many varying interests involved to enable the buyers to form a combine in the auction market. There are Greeks, Hebrews, Irishmen, Germans, Italians, and Americans, both large and small buyers, at every public sale. The auction companies have made combinations impossible by forbidding one buyer to bid for any other who is present at the sales. Buyers who can not be present at a sale are represented by brokers whose business it is to buy at auction sales. Competition in bidding is keen in this striving in the open public sale; and the price of fruit is forced upward to the point at which there is only a small profit for the auction buyer. If not satisfied with the price bid, the seller always has the privilege of withdrawing his offering from the sale.

*Long-keeping and perishable commodities both suitable for auction.*—It is at times asserted that the auction sale is adapted to the selling of highly-perishable commodities such as pears, plums, and certain varieties of grapes, but is not adapted to the selling of long-keeping commodities such as boxed or barreled apples. The auction system in this country was inaugurated in selling long-keeping fruits such as lemons, Almeria grapes, and foreign oranges.

As stated already, in the year ending May 1, 1915, there were imported into England 1,788,236 barrels and 1,096,054 boxes of American and Canadian apples, nearly all of which were sold at auction. High-class winter pears, such as Comice, Winter Nellis, and Easter Beurre, are sold at auction in the months of September and October, are placed in cold storage at the expense of the buyer, and are frequently held until the month of April and even later before being put into consumption.

### IX. AUCTION INCREASINGLY NECESSARY IN DISTRIBUTION.

The volume of certain lines of the fruit and vegetable industry has grown to such proportions that it has become absolutely necessary for the grower to adopt the auction system of selling. There is a point at which the system of private selling breaks down simply because the machinery of the system is not adequate. That point is reached where the distribution has not sufficiently kept up with the production. When the production of a particular commodity is large, in order to secure the best results for the grower, there must be a concentration at one place of both the commodity and the buyer, a minimum number of movements, minimum expense, and speed in delivery. When there is such concentration and the commodity is standardized there is no question but that the auction system is the most efficient method of disposing of the product.

Only a fair trial is asked for the auction system. The offering at auction of an occasional car of a commodity past its prime, as is so often done, in an attempt to test or discredit the auction is unjust. To give the auction a fair trial a quantity of high grades of the commodity offered sufficient to attract the buyer should be supplied the auction regularly for a reasonable length of time.

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## ORGANIZATION BY CONSUMERS.

By HERBERT A. SMITH.

In striking contrast with what the United States can show in the organization of producers, organization by consumers has here made but small headway. It is true that farmers organized for cooperative marketing have also engaged extensively in cooperative buying and have in some cases established successful cooperative stores; but such activities are essentially a part of producers' cooperation. Outside of these the record of achievement is not impressive. If there is anything of value to show for the exertions made it is chiefly the value, as subjects for study, of a large crop of enterprises that went wrong. The object of this paper is to present the causes of the small degree of success which consumers' organizations have had here, and to point out the prospects for the future.

That so little has been accomplished is not for lack of varied experiments. The effort to organize consumers has been going on for more than 60 years and has produced enterprises of many and diverse types. The earliest type to appear was a development from the consumers' clubs which are the natural first step in common action. Stores were opened which aimed to sell to members at as near cost as possible. Some of the stores of this type, founded in large numbers in the middle of the last century, still survive; and in spite of the essential weakness of their basic principle, new stores of the same model are perennially springing up. The next type to appear was that originated by the Rochdale weavers. Recently various stores with features that suggest the Belgian "Maison du peuple" have been established. Other enterprises have been of individual, not to say homemade, design. Invention has been busy in devising variants on the cooperative motive, each expressive of the ideas of some new enthusiast for the rescue of society from the ills of the competitive system.

Consumers' cooperation has been attempted not only in varied forms of organization but also under the stimulus of diverse impulses. Very many enterprises have been brought into being, at different periods, by important popular movements. The successive waves of agitation generally designated as the farmers' movement have been, from the early seventies onward, prolific of cooperative undertakings. The labor movement has had a similar though smaller result. More recently socialism has given some impulse to consumers' organization. Within the last five years the reaction against advancing cost of living, with the public discussion and agitation of the subject of high prices, has engendered a large though not a conspicuously flourishing crop of new ventures. Idealism goaded by dissatisfaction with the selfishness and other shortcomings of the competitive system has inspired many to enlist in the service of the cooperative cause as promising the world a better day. Nor, on the other hand, have there been wanting promoters who have entered the field with an eye single to the main chance, perfectly willing to help cooperation along on condition that cooperation should do the same for them. In short, the motives which have impelled Americans to attempt consumers' organization have been quite as diverse as the forms of organization experimented with, and almost as varied as human nature itself. Lack of success has not been due to any carrying of all the cooperative eggs in one basket.

Neither has it been due to an insufficient number of individual tests. A very large aggregate of stores has been started. How large this aggregate is will never be known, though it unquestionably runs high in the thousands. From the nature of the case the single ventures are innumerable, since many, if not

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most of them, were of too brief life to leave any record. Of isolated survivors, it is true, enough exist to make a not inconsiderable roster, and a few of these have lived through a sufficient term of years to deserve the respect due old age; but compared with the host that have perished, these successes are exceptions which prove the rule. They are presumably to be explained rather by their anomalies or by special causes than by the inherent virtue of the cooperative principle. On the whole, past experience affords on its face little evidence that consumers' cooperation is in the United States generally workable or economically serviceable. Any conclusion that it is must be derived from an analysis of facts superficially unfavorable in high degree to any such conclusion.

By some, if not most, persons the facts are held to have demonstrated quite the contrary. A widespread skepticism exists, indeed, as to whether true cooperation of any kind can take permanent root here. It is constantly said that there seems to be some influence peculiar to this country incompatible with its development. The effect is as though our soil were toxic to its growth. It is held a European exotic, incapable of flourishing in the environment which our economic and social conditions afford.

Such sweeping views require, to be safely accepted, some better basis than the meagerness of positive results hitherto obtained in consumers' cooperation. A high death rate among enterprises which are marked innovations upon prevailing trade methods is no more than should be expected. Most people do not easily change their established habits, and a good idea may therefore fail for a long time to overcome the inertia which prevents it from being generally taken up. To make a success in a new field calls for exceptional managerial ability. The man who wants to start an ordinary mercantile business follows methods that have been fully tried out and gradually evolved. All that he need do is to keep in the beaten path. But a cooperative venture must blaze its own trail. To establish that cooperation can not be made to work in the United States, therefore, better proof is needed than the mere mortality statistics of past cooperative ventures.

But it is not only that the evidence advanced in support of such a view is inconclusive. There is evidence on the other side. The facts themselves disprove the assertion that cooperation can not succeed in the United States. A few years ago, before the farmers had demonstrated so widely their power to organize and conduct successfully cooperative elevators, live-stock selling agencies, creameries, fruit and produce handling associations, purchasing agencies, and the various other forms of cooperative enterprise involved in disposing of a total of some $1,400,000,000 worth of goods annually, there was more plausibility to such views than now. If cooperation works in these enterprises, the failures of consumers' cooperation can not be because Americans are incapable of cooperating. A less sweeping explanation must be found.

In his "Cooperation in New England"[1] Dr. James Ford published the results of a careful study both of cooperative production and of cooperative distribution in the six North Atlantic States. Information regarding the causes of failure was obtained by Dr. Ford from 56 societies which failed in the 15-year period between 1896 and 1911. He gives as the reported causes of most failures "bad management, extended credit, dishonesty, ignorance of business, small capital, and, most of all, the ignorance and disloyalty of members." These causes, he says, may in reality be reduced to two—bad management and lack of cooperation. Back of these causes, again, he finds, if not a common

[1] Cooperation in New England, by James Ford, Ph. D., Survey Associates (Inc.), New York, 1918.

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root, at least a single condition which he regards as usually explaining the situation. "It is the utter isolation of the local cooperative societies in New England," he writes, "that is chiefly responsible both for their frequent failures as business ventures and for the comparative rarity of the true cooperative spirit."

Indisputably, isolation is a sufficient reason to account for many failures. Cooperative organizations are obliged in the nature of the case to run a veritable gauntlet of dangers in their formative stages, and it is certain that, when compelled to do so without counsel or assistance, most of them will fail. They are pretty sure to be made up of people few or none of whom have had the sort of business experience required to plan or conduct a mercantile enterprise on safe lines. Consequently they are bound to make serious mistakes, and the same mistakes are made over and over again. They include attempting to start on too little capital (a mistake almost as certain to be made as the sun is to rise), putting the business in the hands of an incapable manager (and competent ones are practically unprocurable), reluctance to pay a manager what his services are worth, lax business methods, and poor business system. Undue extension of credit and too low prices are especially common pitfalls. It is entirely reasonable to suppose that, with the aid of a parent organizing society or a central supervising or inspecting agency, these stock mistakes might be escaped.

In point of fact such an organization has existed for some years. The Right Relationship League was incorporated in 1906, and reports the number of cooperative retail stores which it has started since its establishment as 124, of which 101 are now alive. It has an auditing department which offers cooperave stores an advisory service in connection with their accounts and finances. The record of this league fully bears out the opinion that a central organization can give very valuable assistance and advice to societies which, if left to work out their own salvation, would probably fail in large numbers.

Nevertheless, the record made by the Right Relationship League does not suffice to establish confidence that with such an agency available the road to consumers' organization lies open. The work of this league has been done mainly in the States of Minnesota and Wisconsin, in which are located 84 of its 101 living stores, while Michigan, Iowa, North and South Dakota, Montana, and Washington have from 1 to 5 each. But none of these stores is in cities. Nor are the officers of the league hopeful regarding the prospects of cooperation under urban conditions. "Cooperative retail stores in large cities are invariably unsuccessful," a letter from the president of the league declares, "because of lack of capital to make them of sufficient importance to become a factor in competition with individually operated and department stores." Thus the experience of the league substantiates the conclusion that successful cooperative stores tend rather to follow in the wake of the movement for producers' organization among farmers than to be capable of gaining independent foothold where the typical consumer lives. It appears, therefore, that isolation alone does not suffice to make clear why consumers' cooperation has so generally failed. Dr. Ford's explanation seems not to reckon with all the facts.

Other students of the subject have reached somewhat different conclusions from his. One of the commonest and most important of the reasons frequently given for the nonsuccess obtained in this country as contrasted with Europe is the absence of economic pressure. "We were suffered into it," a British cooperator is quoted as having said. The higher wages and higher standards of living in the United States make small savings seem less of an object, while the

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fluidity of population due to the general demand for labor tends to disintegrate consumers' organizations before loyalty has been developed to cement them or the habit of cooperative trading has become confirmed by practice. To this may be added the fact that retail business is generally conducted in the United States with at least fair efficiency, and that local competition for trade in towns and cities is becoming more aggressive and severe; while the great mail-order houses have developed a special form of efficient retailing into a business of national scope. Thus the margin of retail profits is already cut reasonably close. The lukewarmness evidenced by what Dr. Ford terms disloyalty may conceivably be symptomatic not of something wrong with the people who ceased to support cooperation but of the inability of cooperation to demonstrate to them any reason for giving it their support. At least it is worth asking whether this may not be true.

The pertinence of such an inquiry is brought home by what Mr. G. Harold Powell has said in his "Cooperation in Agriculture," under the heading, "Agricultural organization must be born of necessity:"

The reason for an industrial organization among farmers must lie in some vital service which it is expected to perform, if it is to have virility enough to live in the face of the competition to which every new farmers' organzation is subjected. * * * Among farmers who under existing conditions are already prosperous, the need of business organization is not usually felt, even though the costs of marketing and the extravagant profits of the middleman or the railroads might be greatly reduced. They must feel the pressure of need before they can launch a successful business association. * * * and the realization of the need must spring from within and not be forced on them from without by the enthusiasm of some opportunist who seeks to unite the farmers on the principle that organization is a good thing. American agriculture is strewn with the wrecks of associations that were the outcome of high motives and impractical enthusiasm. * * * To unite successfully, a group of farmers in the past have had to feel the effect of hard times or of oppression by the railroads, a helplessness on account of a combination among those who buy their products or of those from whom they purchase supplies. They must have had big obstacles to overcome. * * * Successful cooperation develops through a gradual evolution, the mainspring of which, at least in its childhood, must be grim necessity. If it is born prematurely it starts with a weak constitution and expires in the first encounter with adversity. It must be formed by farmers who realize that agriculture is passing through a slow evolution in its adjustment to modern social and economic changes, and that the business of the farmer must be handled collectively rather than individually if the farmer is to share equitably in the increasing prosperity which the better organization of all kinds of industry has brought to the country.[1]

It can not be denied that consumers' cooperation has lacked in this country any such reason for existence as most of this passage sets forth. Farmers have been forced into cooperation; consumers have not. In his concluding sentence, however, Mr. Powell recognizes a necessity for organization created not by an acute situation which must be met at once but by deep-seated social and economic tendencies. The point is made that farmers must handle their business collectively if they are to get their equitable share of the general prosperity. Does the same point hold for consumers? If so, cooperation would certainly seem to have an ample field of usefulness; and we may fairly assume that the reasons for its past ill success are to be found in weaknesses of the forms of organization, not in the lack of any real opportunity for service. The task ahead for those who desire to see cooperation put on its feet is in that case the practical one of devising methods which will work.

If the consumer is failing to get his equitable share of prosperity it is not because of exorbitant profits reaped by retailers. Their competition with each

[1] Cooperation in Agriculture by G. Harold Powell. Rural Science Series, Macmillan, New York, 1913, pp. 21–24.

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other permits few to earn more than a moderate living. Nevertheless, competition does not necessarily mean that the consumer's best interests are served. On the contrary, the competition of retailers may be and often is one of the reasons why the cost of living is high. It is a competition for patronage; but patronage does not necessarily go to the establishment where selling prices are lowest. The assumption that active trade rivalry will bring about the conditions most advantageous for the consumer is one which overlooks some of the facts. Undoubtedly it would bring about such conditions if the normal man were a sort of omniscient automaton moved solely by an intelligent regard for self interest. But he is not. Instead, he is a human being. Where he goes to buy, and what he spends his money for, and how much he will spend, are matters which will be determined largely by salesmanship, not purely by what he most needs and can normally afford.

Competition for business, in a word, has created a special branch of applied psychology. Success in retail trade depends quite as much on skill in making people buy what they would not take or come for of their own motion as it does on efficiency in the operations involved in putting goods on sale. Specialists spend their time in studying how to get people to buy more. It is a common saying that the profit is made not on what the customer comes to buy but on what further can be sold him before he gets away. To a large extent salesmanship is the art of playing upon human weakness to overcome the healthy reluctance of a man or woman with a dollar in hand to give it up. Employees are coached in the use of the most conciliatory methods of winning the patronage of the public, and rewarded for deftness in accelerating the flow of the golden stream which has its small sources in the customer's purse and its wide mouth in the employer's till.

Advertising may be said to have become the life of trade. A concern which should attempt to make its way solely by offering goods of the highest merit at the most reasonable price and expect success to come as the result of an unnursed reputation would be regarded as hopelessly old fogy. It will not do to sit down and wait for people to find their way to your doors. There are too many competitors who count on getting attention by making a loud noise. To earn large profits it is necessary to know how to sell many goods, as well as how to offer good values. In short, competition has developed the art of selling along lines very unlike those which the old-time economic theory recognized. Custom may be attracted, or extracted, in many ways besides that of offering the consumer what is really in his best interest. The man who succeeds is the man who understands how to apply salesmanship most advantageously from the standpoint of profitableness to himself.

In short, the first great fact which a consideration of the characteristics of modern business brings to light is the tremendous and increasing intensity of competition. Conditions at all comparable have never existed before. More and more of the brains of the country are drawn into business. As rivalry for trade becomes keener, efficiency in the conduct of enterprises perforce becomes greater. At the same time the sidewise pressure, so to speak, of competition causes solicitous attention to be given to the extension of business. That the consumer does not benefit largely by the energetic pursuit of his custom and the constant search for more efficient methods of merchandising it would be idle to deny. In a very real sense competition has made it possible for him to get more for his money than ever before. Nevertheless, in many ways his interests suffer.

One result of overstrenuous competition is its tendency to force the introduction of unfair trade practices. A dealer who finds that he is being driven to

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the wall will resort to methods, in order to save himself if possible, which he would not voluntarily choose. Competition tends to the general adoption of the standards of the least scrupulous, as well as of the most astute. Hence the widespread demand and necessity for regulation of trade practices by the State. It has grown increasingly clear that too close adherence to the "laissez faire" point of view invites exploitation of the consumer to a disastrous and intolerable extent. An elaborate but necessary system of control is in process of development to protect the public against trickery, dishonesty, and thimble-rigging of various kinds. Not only must weights and measures be inspected, unsanitary practices prohibited, unhealthful food condemned, and adulterations prevented, but a far-reaching system of standardization must be contrived and maintained to insure the buyer's getting what he pays for. Yet it must be admitted that the day when State regulation can be expected effectively to insure any such result for the everyday citizen in his everyday transactions is far distant.

What cooperation might do to relieve the consumer from the danger of exploitation through unfair trade methods is too obvious to require elaboration. The cooperative store has no incentive for cheating its patrons, since they are also its owners and could make nothing by cheating themselves; and the cooperative store, buying as it does for its patrons instead of in order to sell to them, becomes a central agency for the protection and advancement of their interests by a skilled buyer who can safeguard them at innumerable points impossible for the individual to cover, or uneconomical for each individual to cover in making each purchase.

Another and a very striking result of overstrenuous competition is stimulated consumption. The art of salesmanship is applied not only to hypnotize purchasers into buying what they do not really want, but also to arouse new wants. Against the artificial stimulation of the demand for things involving well-recognized dangers to society, such as habit-forming drugs and intoxicants, repressive measures have been very generally adopted; but simon-pure commercialism still inspires the pushing of many wares which would better remain unsold. Thrift is a virtue the practice of which requires far greater powers of self-denial under present-day conditions than it did when pursuit of the consumer's dollar was less hot. Methods of selling tend to grow more irresistible. In the effort to induce trade services have been greatly increased, and the consumer pays the bill without realizing how much of the higher cost of living of which he complains is due to his consumption of this pleasing commodity. Credit is extended to obtain more business, and the resulting losses must be distributed, adding another item of expense on the consumer's fast-growing account. The cooperative store, however, has no such motive as the competitive store for artificially stimulating consumption, and on this score also it can present strong claims for support.

Still another result of competition from which the consumer suffers is that brought about through competition for cheapness, real or supposed. In the effort to undersell each other, competing tradesmen are likely to seek goods on which a favorable price-showing can be made, regardless of quality. This crying evil is now being partly met through legal requirements regarding standardization and branding. Besides suffering imposition as a result of such cheapness, consumers are very effectively and generally taken in by the jugglery of price-cutting and bargain sales—advertising devices the profitableness of which depends on the skill with which their user recoups himself after having taken advantage of the human weakness for getting something for

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nothing. Cooperative trading could save many consumers from a certain amount of exploitation through such methods, provided they were willing to be saved.

Another opportunity for saving is created by the profit which the consumer now pays on good will. In a cooperative store whatever profits are made on retailer's good will go to the consumer. Good will is the value to a business of its patronage. Retailer's good will has in it an element akin to natural monopoly. To the extent that a customer is predisposed to buy of one man rather than of another, the play of free competition is restricted. The more the customer can be counted on to prefer to buy at a certain place, the more extensive is the monopoly of his custom which the store has.

Good will is, of course, partly the result of methods which build up a high-class business reputation. It is the visible evidence of the investment which the establishment makes, so to speak, in fair dealing and good service of the consumer's needs. But an important part of good will has its source in trade habits and can be explained only by considering the psychological aspects of the matter. We all tend to run in grooves. It is more natural to go where we have been before than to seek out a new place. The customer who can be counted on to come back to a certain store presents the proprietor with the equivalent of the capitalized value of his good will. If the proprietor sells his business, he expects to realize on its good-will value, as well as on its tangible assets. The cooperator invests his good will in his own store and thus makes it possible to obtain the returns on it himself.

A notable development has taken place of recent years in the creation of good-will values by manufacturers and wholesalers, through the instrumentality of advertising. The profits on an article of general consumption which it is possible to reap through nation-wide advertising have rolled up great fortunes, after making good enormous disbursements for the costs incurred. Such profits are partly the result of a transfer of a portion of the retailer's good will to the producer, partly the result of building up an essentially new good will. The advertised article must, after the point has been reached at which the article "sells itself," be handled by the grocer with a margin of profit decidedly below that which he must average on his goods generally. "They have got us where they just about tell a man what he can have to live on," said a grocer bitterly when asked how much he made on a well-advertised brand of butter. But the consumer has found to his cost that package goods are likely to be far more expensive than the same goods in bulk, even though the grocer makes less on them.

An illuminating incident was reported in the papers some months ago. The president of the American Sugar Refining Co. was a witness at a hearing in New York in connection with the suit of the Government for the dissolution of the company. In discussing the introduction and advertising of package goods he is reported to have said: "I came from a patent medicine town in Massachusetts, and I know the value of getting a product inside the home. I thought that if the housekeeper could order goods in a sanitary package it would do the trade good. I thought that if we could standardize the package and get it into the home we would eliminate competition."

"You do not mean 'eliminate competition,' do you?" asked the counsel for the company. "You mean to say you would make a good product against which rivals would have small chance?" "I knew that if we could get the housekeeper we could put a good price on the product," was the reply.

The package goods business has flourished partly because, once you have "got the housekeeper," competition is to a certain extent eliminated. The purchaser



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is not entirely free to choose. The maker has acquired a form of monopoly through a trade habit, and can collect monopoly profits. The president of the so-called "sugar trust" knew that by "getting the housekeeper" it would be possible to put a good price on the product. In this way even the maker of a uniform article like sugar, in the case of which there could be no choice between the output of different refineries, can secure an advantage like that possessed by the maker of a patent medicine, which no rival can manufacture. Thus the consumer pays toll to many others besides the retailer, and would continue to do so if the store were a cooperative one until such time as his organization had advanced to a national stage.

Enough has been said, I think, to show that cooperation has many advantages to hold out. It would seem that a sufficient field of usefulness exists to induce consumers to organize, if methods capable of yielding success can be promised. A pertinent subject of inquiry at the present point is therefore: What further light, if any, can be thrown on the past causes of failure? What must be reckoned with?

One important cause of failure has unquestionably been false initial expectations regarding what could be obtained. Most of those who have gone into organizations of consumers in the United States have done so with the idea that large immediate savings could be realized. It has been imagined that retailers' profits were excessive, and that by "eliminating the middleman," to use the popular but fallacious phrase, a large percentage of the cost of living could be cut off without any corresponding sacrifice. But in point of fact such an assumption is delusive. Only under exceptional conditions can consumers through organization lower the cost of living to an important aggregate out of retailers' profits. Hence support of consumers' organizations based on this false notion has been short lived, and its demise has been very commonly followed by that of the organizations themselves.

Another reason for nonsuccess may be found in the important part which personality plays in building up a business. In large enterprises and in small, some individual or possibly some small group of associates are the important factors in the achievement of any marked degree of success. Some of the most successful of our cooperative producers' associations are said to be founded on the personality of a leader possessed of uncommon qualities. Whether or not cooperative organizations generally will be able to develop leadership will depend partly on the degree to which men will find satisfaction in rendering service rather than making money, and partly on the capacity of cooperators to choose and support and follow competent leaders after they have been found.

A further reason for cooperative failures is the improbability that their management will be characterized by aggressiveness. Men who are spurred on by the desire for profits and whose capital is at stake can generally be counted on to get out and hustle for business. A collective enterprise not only lacks the spur which stimulates the ordinary business man to push hard for a place in the sun, but also suffers a serious disadvantage in its form of organization. Democratic control does not make for swift or daring or original action. In an ordinary stock company control is generally in the hands of a small group of stockholders and responsibility is concentrated, while in an association of cooperators the management must take account of the general sentiment. The tendency is to go slow and take no chances. Conservatism may enable an established business to hold its position, but it is out of place when a new enterprise is to be built up.

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Personally I regard the inferiority of a collective enterprise in aggressiveness as one of the most serious obstacles to wide success under existing conditions. In what it can actually do for its members the cooperative store need not, I believe, fear to stand the test of comparison with the competitive stores which are its rivals. But commercial success depends first of all on ability to compete with rivals for good will; and good will is obtained in many other ways than by giving people their money's worth. It has already been pointed out that one of the advantages of the cooperative store for the consumer is the lack of any occasion for stimulating consumption, for practicing predatory salesmanship, or for employing cheapness as a device for getting the better of the customer unnoticed; but these very advantages become disadvantages when it comes to building up a business. In short, the tradesman has developed certain practices extremely useful to him, which the cooperative store does not wish to employ since they are contrary to the interests of the customer; but because they are devices for getting the better of competitors, the cooperative store is handicapped without them.

In other words, the cooperative store is handicapped by its obligations to its customers. The competitive store can use methods that the cooperative store can not. A cooperative store does not, properly speaking, sell to its patrons; it buys for them. It is their agent. The adverse interest always involved in the ordinary relation of buyer and seller does not exist; for whatever the store makes belongs to those whose business has yielded the surplus. As the agent of its patrons it must consider and protect their interest first of all, and it must abstain from any practices which would benefit the store at their expense. It can not consistently do otherwise than maintain high standards, deal in all ways honestly and fairly, choose its stock from the standpoint of what is really most desirable for the consumer instead of the standpoint purely of what can be sold most advantageously to the store, and in every respect live up to the responsibility imposed by the exercise of a trust. In contrast with all this, competitive business has its obligation primarily not to those who buy from it but to those whose money has been put into it with the expectation of making a gain. Its owners may or may not have a high standard of business ethics and a genuine desire to be serviceable to society at the same time that they prosper personally; they may or may not be persuaded that honesty is the best policy and that therefore the right path to business success is scrupulously fair dealing. However that may be, sooner or later the point is reached at which the principle of "caveat emptor" applies. Sooner or later, that is, the interest of the customer and their interest part company. Always the fundamental fact holds that the object for which the store is run is the benefit of the seller. An ordinary store can attract trade in ways which a cooperative store, if true to its principles, must forego.

Now we begin to understand why the average man who has been induced to undertake cooperation soon loses interest. He does not regard it as particularly worth while largely because he is not in position to recognize its merits. While there are many people who discover its practical value, they are likely to be exceptional people. That collective ownership would, if carried far enough to have important power, enable consumers as a class to get their equitable share of the general prosperity may be demonstrated never so thoroughly to the everyday citizen without his finding it a sufficient reason for taking personal action; and of less immediate reason he is oblivious. The man who goes in for cooperation because he is convinced that individualism is bound to lose out in the long run is the most valuable kind of a convert to the cause, for he will possess the quality of loyalty of which cooperators so fre-

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quently have occasion to bemoan the lack; but he will also be a rare specimen. The average man does not take practical account of matters that lie so far ahead or so far away.

In short, a dilemma presents itself. The question is, How is the thing to be accomplished? Consumers generally have no consciousness of being exploited. Those of them who are most fully convinced that they are do not know where to put the blame. There was much resentment over the high cost of living before the business depression from which we are now emerging diverted public attention into new channels, and with the expansion of business and trade activity the question of living costs may again come to the fore; but many explanations are possible, and the consumer is unlikely to reach any conclusion as to whether or not he has just cause of complaint against anyone or anything in particular. Those who see that a necessity exists for consumers' organization have therefore no present way to demonstrate to the mass of consumers that they would gain by organizing, and no way to get the thing tried without a demonstration. If the crowd is to be drawn into cooperation, it must be shown that some definite, practical, immediate inducement is offered; but this is just what cooperation is unable to show.

Very generally those who are active in consumers' cooperation are now saying that before any important showing of results can be made there must be cooperative wholesaling. Since, however, the formation of a wholesale society must await the upbuilding of a sufficient number of retail stores to afford the necessary support, the situation is not greatly improved. It is, therefore, not surprising that the present is a time of hesitation, if not discouragement, among the leaders of consumers' organization in this country. Many new enterprises were started two, three, and four years ago, in the expectation that enough could be saved in the retail field to make the venture a glowing success. Probably a majority of these enterprises have already failed, while almost none are out of their probation period. From every side is heard the same story—that competition in the large cities is so fierce as to make it almost impossible for a cooperative store to thrive.

Out of the dilemma created by this situation believers in the deep-seated need for consumers' cooperation have sought an escape by declaring that the first requisite is education. The long-range point of view must be cultivated. Further, self-interest as the dominating motive must make place for a certain measure of interest in the group or general welfare. Adherents must be won through a process of individual conversion. Those who have given themselves to organizing cooperation of any kind are almost unanimous regarding the fundamental necessity for a support based on convictions and principle, if success is to be realized. Confronted with the unwillingness of the general public to join heartily in the projects for collective action in the collective interest, they call for the cooperative man. Their demand for loyalty to the common enterprise, for willingness to face difficulties and endure discouragements and be governed by larger considerations than those of personal advantage sounds at times like an admission of the impracticability of the whole affair.

Why, it is natural to ask, should people cooperate if they do not find their account in it? Is it not a matter of business, to be undertaken or dropped on business grounds purely? What has loyalty to do with the case? The answer given is that cooperation, to those who have once got into the spirit of it, is more than a matter of business. It becomes a faith. It is worth while because of its promise as a remedy for deep-rooted evils. It is a measure of social amelioration, which, however, to be realized must effect an alteration of the individual's attitude. With private selfishness it is in irreconcilable conflict;

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and it can not thrive except by substituting as the motive of conduct the spirit of neighborliness and helpful association in place of the spirit of rivalry and individualistic struggle. These views are, however, unimpressive as a practical program. For the cooperative man must be developed by the actual practice of cooperation. Until enterprises can somehow or other be got going and kept on their feet the proposal that we attempt to make headway by adopting a program of education seems to have no greater merit than the ideas previously examined. Progress must be developed by the actual practice of cooperation. Progress involves a starting point; and it is precisely the matter of getting started that constitutes the main concern.

Along what line, then, shall those who believe that consumers' organization is needed as a means toward a less unequal distribution of prosperity direct their efforts? Is there nothing to furnish a clew to the right course? Valuable conclusions can be drawn from the relative tenacity of life shown by some of the cooperative enterprises undertaken by foreigners in this country. A significant fact to ponder when it begins to seem that cooperation is a sort of "no thoroughfare" into which the public enters only to back out, is the apparently superior capacity possessed by groups of people of other nationalities living in our industrial centers for loyal support of a collectively owned business. It is not surprising that such groups, drawn together by the sense of what they have in common as well as by the sense of strangeness in their environment, should display exceptional cohesiveness. They have that without which all attempts at common action are bound to be futile—willingness to cooperate at a sacrifice.

Whatever develops in groups of men and women neighborliness and the practice of association for the common welfare, makes them readier for cooperative business enterprises. But the bulk of those Americans who can be got together under ordinary conditions to form a cooperative consumers' organization are unregenerate individualists. They are interested not in the ultimate triumph of a common cause, but in the immediate realization of a personal pecuniary advantage. They are, in short, inquiring the way to the bargain counter. If experience has proved anything whatever regarding the cooperative store, it has proved that the bargain-counter idea is quick poison and sure death. On that tack competitive business can sail fastest every time.

It follows that cooperation will have its best prospects of success when organized among a group of people already conscious of common interests and mutual relationships. It should give expression to something of a club idea. Clubs are immensely successful because they combine personal advantage with a sense of something larger to which one "belongs." The best place for cooperation to start is where it is already started. It may be in the labor union, or the church, or the neighborhood, or the place of employment, or wherever else men and women begin to find it easy and natural to do things together. Only let cooperation not be entered into in the belief that it is going to reward its participants with something for nothing. Persons looking for a get-rich-quick device should apply elsewhere.

It is sometimes held that only among the hard-circumstanced can it be expected to succeed. This I do not believe. The kind of advantages which it has to offer seem to me the kind which those comfortably well off are likely to value at the outset more than those who are obliged to live close. Where communities can be found that are made up of individuals having a certain social homogeneity and sense of common interest, and having incomes sufficient to relieve them from the necessity of overstrict economy, a high-class store owned by and operated for its members, with primary attention to quality and honesty and with lowered costs as a secondary inducement, should be able to prove its usefulness.

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Another opportunity for the cooperative store is created in the need for study of means for lessening the wastefulness of established methods of handling food products. One of these elements is the waste of service. The particular cooperative organization with which I happen to be connected constitutes an experiment in this field. By a mail-order system, staple groceries and the less perishable fruits and vegetables are handled with a material saving of time both for the store force and for the housekeeper; while the cost of delivery service is brought to a minimum through sales of a week's supply of goods together.

A larger field for experiment is presented by the waste which takes place under the methods by which city markets now receive their supplies of farm products. Part of this waste is due to shipment by the producer of ill-graded or low-grade material. Another part is due to deterioration while produce is passing through various hands to the consumer; and still another to maladjustments of supply and demand. To what extent consumers' organizations working with producers' organizations might be able to contrive a system which would reduce waste to a minimum is a very interesting question.

Under an arrangement between the two, the city cooperative store would take and transmit to the proper producers' association orders for whatever quantities of goods it could dispose of. Through a carefully devised system of standardization, previously agreed upon, the delivery of goods of a specified grade would be provided for. The producer would pack these goods by methods also previously agreed upon, so that the articles might reach their destination in the best possible condition. Prices would presumably be determined on the basis of retail prices of the day, since these are far more stable than wholesale prices, the producer receiving the fair average retail price less a reasonable percentage.

Thus the necessity of passing produce through the wholesale market in order to determine its value would be obviated. The producer would ship the quantity for which a market existed instead of taking his chance of encountering a glut. Grading would take place at the source. Direct connections would place the goods in the consumers' possession in the shortest possible time. The production of high-grade goods would be encouraged. Fair dealing throughout would be assured by the assumption of responsibility on the part of the producers' association, for the intelligence and strict honesty with which the agreement between the two associations would be complied with, and by the assumption on the part of the consumers' association of responsibility for intelligent distribution.

If any such plan could be worked out it would enable the consumer to get far better produce and the farmer to get more money. To bring the two together, however, an intermediary agency is necessary. Agricultural specialists should draw up the specifications regarding standards, and should prescribe the methods of production and shipping necessary to secure the best results. It should also put organizations of producers and organizations of consumers in touch. It would be small business at first, but the importance of the results, were it once to be demonstrated that consumer and producer could, thus organized, deal directly with each other to mutual advantage, might be unexpectedly great. The experimental test of such a plan would seem an appropriate activity for a governmental agency charged with such duties as those of our Office of Markets in the United States Department of Agriculture.

## Adjournment.

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## JOINT SESSION OF SUBSECTIONS 1 AND 3 OF SECTION III.

RALEIGH HOTEL,
*Wednesday morning, January 5, 1916.*

Chairman M. R. CAMPBELL.

GENERAL TOPIC:

**Pan American theme: "Conservation of the Natural Resources of a Nation through Government Ownership or Control."**

The session was called to order at 9.30 o'clock by the chairman.

The CHAIRMAN. As announced yesterday, we shall continue this morning the so-called Pan American subjects which are thought to be of prime importance in this congress. The first paper we are to hear has been prepared by Mr. W. C. Mendenhall, Chief of the Land Classification Board of the United States Geological Survey. Unfortunately Mr. Mendenhall is ill and unable to be present to-day, but Mr. Ball has kindly consented to read Mr. Mendenhall's paper.

### THE FEDERAL GOVERNMENT AND THE NATION'S MINERAL RESOURCES.

By W. C. MENDENHALL,

*United States Geological Survey.*

The value of the mineral products of the United States of America for the year 1913 was nearly $2,500,000,000, or more than $25 for each inhabitant. In 1880 the value was a little less than $365,000,000, or about $7.25 for each inhabitant. The total output, therefore, in 1913 was nearly seven times and the per capita output nearly three and one-half times that of 1880—33 years earlier. These figures demonstrate the astonishing absolute and relative increase in the importance of the mineral industry of the United States. It follows, of course, as a corollary of this growth that there is a widespread interest in all problems connected with mineral production, including the relations of the General Government to that production and perhaps especially in the attitude of the Government toward those original sources of mineral wealth, the deposits existing in the public lands.

The magnitude of the industry, the rate of its growth, and the intensity of the interest are sufficient justification for a brief review in general terms of the relations which the Government holds toward the mining resources of the Nation and of governmental actions affecting the mining industry.

These relations and these actions are of two distinct types. As the proprietor of the remaining public lands the Nation exercises the right of owner-



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ship, and through Congress may withhold or alienate, develop or reserve, lease or sell, conditionally or unconditionally, as it wills.

But as to the minerals in private ownership, whether they have been legally acquired from the Government itself or exist in lands that never were a part of the public domain, the Government has only the limited powers that depend upon the constitutional right to regulate commerce between the States and between this and other countries. This power is very general in character and is held in common with the power to regulate other forms of commerce than that in minerals, so that it does not constitute a right that justifies especial consideration of mineral resources apart from other commercial resources. The mineral deposits now privately owned, therefore, while they are properly matters of national interest and are the objects of scientific and statistical study, do not require or receive from the public official, whether he be legislator or administrator, the attention that is given to those mineral resources which exist in the public lands or in those alienated lands the mineral rights to which have been reserved by the Government for separate distribution. These lands form but a small part of the area of the country, less than 800,000,000 acres out of 2,000,000,000 acres, or say, 15 per cent of the land surface of mainland United States.

Facts have not been assembled upon which may be based a reasonably accurate estimate of the relation of the mineral resources upon the public lands to those which have passed into the hands of individuals. The reserves of many classes of deposits can not be estimated with any approach to accuracy in advance of detailed exploration, and, furthermore, with improvements in technical processes or in transportation conditions, what is country rock to-day becomes ore to-morrow, so that attempts to estimate general ore reserves are wholly futile. As to other types of deposits, like coal and phosphate, that may be and indeed have been estimated, no attempt has been made to separate in the estimates those reserves in public from those in private ownership.

But such estimates are not in any wise necessary to the present purpose. It is sufficient to know that the Nation as a proprietor still owns great areas of mineral land in order to realize that the problem of the proper management of these areas and their contents is a problem of magnitude and of great public interest.

In the earlier and middle periods of the Republic's growth our problem was like that of some of our neighbors in this hemisphere to-day—that is, essentially a problem of settlement and development rather than one of conservation. Our statesmen were concerned chiefly in attracting settlers to vacant lands, in establishing industries by the development of undeveloped resources, in encouraging and extending means of transportation so that human habitation might be not merely possible but attractive, free from undue hazards and hardships, and attended by opportunities for education and social intercourse. In short, both the undeveloped condition of the country and the relative abundance of our mineral wealth during the first half of our existence as a nation excused us, if they did not entirely justify us in expending those resources prodigally in extending colonization and settlement so that they might render the quickest service in furthering national development. Forests and lands and minerals do not become useful to men until there are men to use them. The first task in an unsettled country is to bring about settlement. Important as forest conservation now is in Ohio, Indiana, and Michigan, it was not so important to save the trees a century ago as to build houses and clear the land for cultivation. Although no one would advocate now the making of immense grants of public land to induce railroad building, that may have been a wise policy 40 or 50 years

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ago, for it brought about the prompt construction of trunk lines across the continent and thus made accessible the remainder of the public domain.

Therefore, although in common with other conservationists I regret that the idea of conservation in the sense of wise use with full consideration of future, as well as immediate needs, was not comprehended earlier by our countrymen, yet I feel that that fact is not a matter of surprise nor especially for criticism. I am inclined to think that such criticism results from our inability to visualize the conditions of that earlier time. We incline to discuss the acts of two or four generations ago from the point of view of to-day. Had the Nation awakened earlier to the need of wiser laws and less lavish expenditure of its patrimony there would now undoubtedly be a larger proportion of our resources over which the Nation could exercise direct control for the benefit of its citizenship, but it is scarcely believable that there would be any markedly greater proportion unused, for no one advocates withholding these resources from use. Waste and loss would doubtless have been lessened, but in the case of most minerals the amount wasted is an almost negligible percentage of the mineral wealth that remains, so that the quantitative effect would have been small. The chief effects of proper legislation written into the statute books earlier would have been to prevent the passage into private control of so large a proportion of our unused mineral wealth. This is important and it is regrettable that steps were not taken to this end, but it is not vital. If it becomes necessary to the national well-being we shall find other means of controlling private use of our mineral wealth than through the exercise of a proprietor's rights.

Governmental functions in their relations to all of these problems fall into two general classes, corresponding to two of the three fundamental divisions of the Federal Government—namely, the executive and the legislative. Although these functions are distinct and are performed by entirely different groups of men, they are very closely interdependent. All executive acts depend upon the law, for they are but the administration of law. Congress enacts the laws and the Executive administers them. Congress indeed creates the departments and bureaus which are the instruments of administration. On the other hand, the experience of the Executive in administering the law, and the vast body of facts secured by the great departments and bureaus in carrying out the duties assigned them, are utilized by Congress in considering new enactments.

The facts thus developed may indeed be the principal basis for new legislation. Thus it happens that the work of the governmental investigative organizations on problems related to the Nation's mineral resources exercise both a direct and an indirect influence on the mineral industry. Its primary purpose is to assemble facts and establish principles that will be useful to the mining world. By the accomplishment of this purpose its direct influence is exercised. But the principles established and the facts collected, when made available to the country by general publication, lead to a clearer understanding of the subject matter of mineral land law by both laity and lawmakers and help to create a demand and to establish a basis for new legislation that will give statutory expression to the opinion of the time.

The beginnings of a systematic study by the Federal Government of its public domain are found in the long series of exploratory surveys which followed the Louisiana purchase.

Lewis and Clark, Long, Schoolcraft, Bonneville, Fremont, Pike, Simpson, Warren, and many others added chiefly geographical knowledge to our information about the great domain west of the Mississippi. But Blake, Newberry,

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Marcou, Antisell, and Schiel, attached as geologists to the Pacific Railroad surveys, made the beginnings of western geologic studies. After the Civil War, interest inspired by the accounts brought back by these geographic and geologic explorers, led to the organization of better equipped expeditions, and closer scientific work began, some of it modelled after the work of the great surveys of the Eastern States like those established by the Rogers brothers in Virginia and Pennsylvania, Safford in Tennessee, Hilgard in Mississippi, and Hall and Whitney in Iowa.

The period from the middle sixties to the late seventies, then, is the period of the organization of the great national surveys and represents as it were the awakening of the Federal Government to its duty toward the resources of the great western public domain. It began to realize the necessity of determining the various classes of lands there of which it found itself the proprietor, and of making fundamental studies in geology as a foundation for this classification and this investigation of the resources of the public lands. The four great public surveys of this period were the geological survey of the Territories under F. V. Hayden; the geographical surveys west of the one hundredth meridian by Lieut. George M. Wheeler; the geological exploration of the fortieth parallel by Clarence King; the geological and geographical survey of the Rocky Mountain region by J. W. Powell.

Wisely and perhaps inevitably these independent organizations, sometimes with overlapping and conflicting jurisdictions, were combined in one national survey. This was brought about by the act of March 3, 1879, which created the present United States Geological Survey. The experimental work of the first national surveys, extending over a decade or more, had developed a group of master investigators of geologic problems and had established the general methods which, with constant improvements and refinements of course, have been followed since.

It was established, for example, that topographic surveys must precede and serve as a basis for geologic surveys, and the methods of making these topographic surveys were developed. It was recognized that general geologic surveys must precede and serve as a foundation for detailed study of mineral deposits and that topographic and geologic and hydrographic surveys must precede the classification of the lands into those types recognized in their use and as a basis for their disposition.

The opinions and experience of those who conducted the early national surveys were clarified and crystallized in the discussions in the National Academy of Sciences and before the committees of Congress that considered the coordination of these surveys into one and were finally expressed in the clause of the act of 1879, defining the duties of the new organization as follows: "The classification of the public lands and examination of the geological structures, mineral resources, and products of the national domain."

During this period immediately following the Civil War when the beginnings were made in systematic geologic explorations and study of the resources of the national domain by the administrative branches of the Government, the chief provisions of our mineral land laws were also enacted. These laws were in the main formulated between 1865 and 1875, and in their essentials they remain the law to-day. At that time the known deposits of importance on the public domain were of metalliferous minerals, and the laws governing the acquisition of these deposits were in essence a statutory expression of the rules worked out by the California gold miners, who found themselves without a law governing their industry. But two classes of claims were provided for, lode and placer, and as one or another mineral has since become important, provision has

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usually been made for its acquisition under one or the other of these statutes. The oil-placer act of February 11, 1897, is a striking example of the hasty placing of one class of deposits under a law designed for a totally different class of deposits. Coal was an exception to the general tendency to require all minerals to be developed under either the lode or placer law. The lawmakers recognized something of the conditions of its occurrence and a special statute was written to control its disposition on public lands. The decade, 1865–1875, therefore saw the beginning of governmental study of the Nation's mineral resources and the enactment of the first general mining laws. Throughout the period from that decade to about the end of the first decade of the present century these laws have governed mineral development on public lands. Mining engineers and operators have accumulated an abundant experience as to the difficulty of applying these statutes to the wide variety of deposits that were developed. Courts and departments have construed and reconstrued the archaic laws in desperate endeavors to make them fit the complex conditions recognized. But we have not changed them; we have somehow muddled through. But no man can estimate the waste in litigation and uncertainty that has resulted.

Meanwhile, the Geological Survey, starting in 1879 with an appropriation of $100,000, was making a beginning on the large task assigned it and was continuing and improving the work of its predecessors, the territorial surveys. There came into existence by its creation a medium through which the Federal Government could secure information on questions related to the mineral and other products of the national domain, and since its establishment the Survey has been accumulating and making available through its series of widely distributed reports systematic information upon many phases of questions related to the national mineral resources. As one of the products of the public lands it has made systematic studies of the water resources, particularly of the arid West. These studies, begun in a small way in the topographic branch, and later were recognized as of sufficient importance to justify the organization of a separate branch. The results secured led finally to the passage of the reclamation act and the organization of the Reclamation Service. So, also, the work of the survey on the forests of the western United States from 1897 to 1905 aided greatly in laying the foundations of the Bureau of Forestry, which was organized in the latter year as a bureau in the Department of Agriculture. Other studies incidental to the general investigations of the mineral products of the United States led to technologic investigations of ores, fuels, and structural materials and this work expanded until it also required the creation of a branch within the Geological Survey, and this branch eventually was organized as a separate bureau in the Department of the Interior—the Bureau of Mines. Thus it may be said that the expansion and development of the ideas which underlay the organization of the survey in 1879 have resulted in the creation of three great bureaus in addition to the parent bureau, and that each of these is now doing constructive work upon scientific and engineering aspects of the general problem of the mineral resources or other products of the national domain. They represent in part the steps that have been taken by the Federal Government toward the acceptance of its responsibilities for the national lands.

To mining men one need but mention the work of Emmons and Becker in Leadville and Eureka and of Irving and Van Hise in the Lake Superior district, establishing the fact of replacement of the inclosing rock as a method of formation of ore bodies or the clear recognition by Emmons and others of the distinction between the oxidized or altered minerals and the original or sulphide minerals of ore deposits, or the explanation by Emmons and Weed of the

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bonanzas so frequently found just below the oxidized zone as the result of a process of secondary enrichment by leaching above and redeposition as sulphides below, or Lindgren's researches on metasomatic processes and on contact deposits, or the thoroughgoing detailed studies by Ransome, Spurr, and others in order that they may fully recognize the value of the contributions made to mining science by the Government investigators.

Contemporaneously with these fundamental researches the more prosaic but scarcely less useful task of outlining by the methods of geologic mapping, the various metalliferous fields has been pursued in order that the work of the prospector may be directed toward the promising areas and away from those of little or no promise.

Similar work has been steadily pursued with increased intensity and attention to detail in the field of nonmetallic mineral resources. For five decades Federal agencies have been engaged in studying and mapping the coal deposits of the Nation, until at the present time not only are all the important fields known, but their areas are closely delimited, boundaries in many cases having been traced with great accuracy, and, indeed, in many of the fields individual beds have been followed, mapped, and their thicknesses and qualities studied in detail, not merely contemporaneously with development, but far in advance of it, so that there is available to those who propose to engage in development a great body of reliable facts which is eagerly sought as a preliminary to commercial exploitation. In many of the western coal fields which involve public lands the Government during the past nine years has opened, examined, and traced coal beds and determined the structures in which they are involved as a basis for fixing the prices at which it, as a proprietor, will dispose of these deposits.

Of late years the search for and examination of lands containing mineral fertilizers has occupied no small share of the attention of the General Government. Phosphates were first developed in the Carolinas and later in Florida and Tennessee, and much the greater part of the production is still from these Eastern States, but a beginning has been made in the northern Rocky Mountain province. The Federal Government has assisted the Eastern industry by its studies of the origin and conditions of occurrence, but in the West, through the labors of its scientific staff, it has vastly extended the areas in which beds rich in rock phosphate are known to exist; so that it is now realized as a result of these researches that the United States has deposits of this source of phosphoric acid which make it independent of the rest of the world and constitute an invaluable safeguard against the time when its still fertile soils shall require continual renewing of phosphoric acid in order to maintain their productivity.

The work of the Bureau of Mines on the quality of coals, on the technology of oils, on the extraction of radium, should be mentioned, and still the list is only begun.

The research work of the Government, then, on problems connected with the Nation's mineral wealth is steadily pursued and is steadily finding new ways of making itself useful to the mining industry.

Meanwhile, the old laws enacted 40 or 50 years ago still govern in the main; but the Nation has become restive under these laws and their effects. Those attempting mining development found them often unworkable. There were undoubtedly evasions on a large scale. The public domain was rapidly diminishing and the mineral resources were with equal rapidity passing from public control. The conservation movement expressed this national unrest. The Nation began definitely and consciously to take stock, to try to find out what

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as a nation it still possessed, and whether it was managing its mineral resources wisely. It discovered enough disturbing facts to cause it to stay its lavish hand. It began to put prices upon coal lands, prices that bore some relation to their real value, instead of selling them at the lowest price that the statute permitted. The authority had existed since the enactment of the coal land law in 1873, but it was not used until 1906. The President ordered the fast-diminishing public oil lands withheld from acquisition, because the future needs of the Navy must be considered, and to give Congress time to enact a substitute for the absurdly misfit placer law. No specific statutory authority existed for his act at the time, but the authority was later granted by Congress and still later broadened, and its first exercise has recently been upheld by the Supreme Court. So that the legal situation, quiescent for 40 years, is now being thoroughly reviewed, with a strong likelihood that there will be far-reaching revision, and that laws safeguarding both the Nation's interest and the interest of those engaged in the mineral industry, will shortly be enacted. Bills changing entirely the legal principle underlying the Nation's disposition of its mineral wealth have been introduced for several sessions, and long hours have been devoted to their consideration by the appropriate committees of the House and Senate.

A law providing for the leasing of coal lands in Alaska, several laws providing for the partial separation of mineral and agricultural estates, and others providing for the disposition of agricultural lands on the basis of their classification as irrigable or nonirrigable have already become law. Bills providing for the leasing of other mineral lands and of lands valuable in water-power development have passed one or the other house, and their passage is urged by the administration, so that the legal foundation of much of our development of public lands is being changed. It is probable that the next decade will see even greater changes than the past decade in these respects and these changes are all rooted in the recognition of the inadequacy of the Nation's past administration of its public resources, a recognition that lay at the base of the conservation movement.

In summary of this review it may be said that after the Louisiana Purchase in 1803 the Government of the United States found itself in possession of a vast but little known domain beyond what up to that time had been its western frontiers. In the period up to the beginning of the Civil War it was engaged in parceling the land in the eastern, most accessible and agriculturally most important part of this new acquisition and in gaining geographical knowledge of the portions farther west. These western areas were then still inaccessible because not penetrated by railroads. They were of relatively little value agriculturally, but contained, although this condition was then but dimly realized, the most varied and some of the most valuable of the Nation's mineral deposits. The Nation's energies during the decade from 1860 to 1870 were largely consumed in the war and in the adjustment of the problems left by the war. But toward the end of this decade and throughout the next the national energies reached out into the remoter portions of the West. The Federal Government awakened to its responsibilities toward this domain and organized four great surveys for the exploration of parts of it from the geographical, geological, and agricultural points of view. These surveys established methods of exploration and scientific research suitable for the new lands and were finally merged in one organization, the United States Geological Survey—a bureau still existing. This bureau and the bureaus which have sprung from it have steadily pursued their investigations of many problems related to the mineral industry including a study of geology, of the natural laws governing the formation of

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mineral deposits, of the distribution of mineral reserves of all types, of water supply and irrigation, and the results of these researches have been made available to the public. Public opinion, educated by the mass of facts thus made available to it, partly as a result of these governmental activities and partly as a result of the experience of those engaged privately in the development of the West, realizes that the Nation's attitude toward its mineral resources should in the future be one of closer guardianship than in the past; that the mineral industry has been hampered by misfit and inadequate laws; and that the Nation's right as a proprietor and its interests in its property are likewise not duly provided for by existing statutes, so that there is demand for a revision of many of the laws controlling the development and use of the products of the national domain. This demand is in some cases in the direction of greater liberality and in others in the direction of greater strictness, but appears in general to be for more definiteness and clearness and for entire fairness both toward those who seek the opportunity to develop the resources on the public lands and for the rest of the people of the United States, who, in the rôle of consumers, must purchase and use the products thus developed.

The CHAIRMAN. Any discussion on the subject immediately before you or the papers of yesterday would seem to be in order. As the subject of Government ownership or control versus private control has been made a prominent feature in these papers, and as the Government ownership side of the case has not been fully developed here, any one that chooses to say something on that side, I am sure would be heard with interest. We have several gentlemen here who are familiar with the subject I am very sure. If there is no discussion on the paper we will proceed to the consideration of the papers on the utilization of water power. This is also a continuation of the discussion of yesterday morning.

The first paper, "Principles of a Federal water-power policy for the public lands of the United State," is by Mr. O. C. Merrill, Chief Engineer, United States Forest Service.

## PRINCIPLES OF A FEDERAL WATER POWER POLICY FOR THE PUBLIC LANDS OF THE UNITED STATES.

By O. C. MERRILL,

*Chief Engineer, Forest Service, United States Department of Agriculture.*

The first problems in connection with the use of the public lands of the United States for rights of way for the conveyance of water arose some 60 years ago, soon after the discovery of gold in California, when the miners had gone upon the public lands within that State and built canals for use in mining operations. Such rights as the users possessed were merely rights by sufferance, held with the tacit consent of the United States. The controversies that arose were first settled according to the local customs of the mining camps, later by local laws and the decisions of courts. But these laws and decisions, in so far as they affected public lands, were not binding upon the United States,

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and to correct the situation Congress in 1866 passed an act confirming the rights that had hitherto been held by mere priority of possession, and providing for the subsequent acquisition of rights of way for mining, agricultural, and manufacturing purposes.

It was not until 24 years after the passage of this act that the first commercially successful alternating-current plant ever constructed, generating single-phase current at 3,000 volts and transmitting it at that voltage for about 3 miles, was constructed at Ames, Colo., antedating by about a year the famous Frankfort-Lauffen experiments in Germany. Two years later (in 1892) the first transmission with stepped-up voltage was put into operation over some 14 miles of line from the San Antonio plan, and in the following year the first polyphase plant began operation at Redlands, both in southern California. Three years after the construction of the Redlands plant, and 30 years after the passage of the original right-of-way act, Congress enacted the first legislation which made specific provision for electric power development upon the public lands. While the earlier act granted rights of way in the nature of an easement, perpetual in duration unless unused or abandoned, the later act of 1896, superseding the act of 1866 as far as rights of way for power development were concerned, gave only a license or permit, the duration and condition of which were to be determined by the Secretary of the Interior.

Five years later Congress passed still further legislation, which in effect reenacted the law of 1896 and extended its provisions to include other classes of uses and to make it applicable within certain national parks. This act of February 15, 1901, also granted merely a permit to use the public lands and specifically provided that any such permit might be terminated at the discretion of the officer granting it and should not be held to confer any right or easement or interest in the land. This is the act under which power developments have been made and continue to be made upon the public lands of the United States.

Because the act of 1901 grants only a permit and fails to give that security of tenure which the magnitude of the investments made under it would warrant, bills have been introduced at various times in Congress providing for different forms of grant. Among these proposals have been: Leases under certain restrictions, easements with neither restriction nor regulation, grants with authority to the grantee subsequently to purchase the land occupied at a nominal price per acre, title by condemnation under State law, permits subject to State regulation, and grants to the several States with use under State law. None of these bills have become law, except one approved March 4, 1911, granting 50-year easements for transmission and distribution lines.

The first regulations under the act of 1901, as issued by the Secretary of the Interior, merely prescribed the manner in which an application should be prepared and filed, and the procedure under which it might receive approval. No formal permits were issued, the Secretary merely noting his approval on the maps of location. Following the passage of the act of 1905, by which the national forests were transferred from the Department of the Interior to the Department of Agriculture, the Forest Service of the Department of Agriculture undertook the preparation of regulations which should go beyond a mere record of the initiation of rights and of their approval, and which should recognize and establish the underlying rights of the public in the public lands. There were no precedents at home to follow. Those abroad did not afford a complete parallel. Regulation in other countries was exercised under the general police power of the Nation. Here it must be exercised under the rights of a proprietor. The early regulations were, therefore, necessarily tentative and subject to modification as experience might show its desirability. Ten years of such experience

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have finally resulted in the establishment of certain definite principles of water-power administration which have been made applicable to both the public lands and the national forests.

In the administration of water powers the Federal Government requires that the applicant make a showing in the form of maps and plans of the extent and character of the proposed development; that the power site shall not be held without use, but that construction shall begin within a reasonable time and be prosecuted with reasonable diligence, and that the plant shall be operated continuously after completion; that the permittee shall pay a small annual rental, no more than sufficient to defray a reasonable share of the costs of administration, maintenance, and protection; that he will abide by reasonable local regulation of rates and of service; that he will not attempt to put a valuation upon his permit in any proceedings for the fixing of rates or of service; and that upon receipt of fair remuneration he will transfer his permit and the properties used in connection therewith to any municipal corporation which may apply therefor and which would have the right to condemn his properties under the State law were they not protected from such action by their location upon the public lands. This, in brief, is the history of water-power legislation with respect to the public lands and the salient features of the administrative policy which has been developed by the executive department of the Federal Government.

When the act of 1901 was passed the total water-power development of the United States was less than 2,000,000 horsepower. More than three-fourths of this was used in manufactures; less than one-fourth by public-service corporations; and only one-tenth was developed in the western or public-land States. To-day, 14 years later, the total development is in excess of 6,000,000 horsepower, and the Western States have one-third of the total. The ratio of public-service use to manufacturing use has been reversed in the 14 years, and to-day public-service use involves three-fourths of the total, manufactures only one-fourth.

The most striking fact in connection with the increased utilization of water powers has been the extensive development of the South Atlantic and of the Western States. The latter in particular have had a remarkable development, increasing from less than one-fourth of a million horsepower in 1901 to nearly 2,000,000 horsepower in 1915, more than doubling each four years. In rapidity of development and in extent of development in proportion to population the Western States lead all other sections. The amount of developed power from all sources—steam, water, and gas—in the Western States in 1912 was two and one-half times as much per capita, and the amount of water-power development alone four and a half times as much per capita as in the remainder of the United States.

Of the total water-power development of the Western States at the present time 42 per cent is in plants occupying national forest land either for some part of the immediate generating plant or for storage reservoirs upon which the generating plants are directly dependent. Fourteen per cent more is likewise dependent upon the use of public lands outside the boundaries of the national forests. Fifty-six per cent of the total developed water power of the Western States is in plants which either occupy, or are directly dependent upon, the use of the public lands of the United States, as such occupancy and use is authorized under existing law. When it is further understood that there is scarcely a power market of consequence in the Western States to-day that is not already overdeveloped, and that the great need is for more users rather than for more power, it will be apparent that neither the imperfections of the present law, nor any administrative policies of the Federal Government, nor

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any lack of more appropriate legislation have appreciably retarded the power development of the Western States in general, or of the public lands in particular.

Along with the rapid development of water power has gone an equally rapid concentration in its control. This is evidenced by the continuously increasing tendency toward concentration of power development into the hands of public-service corporations as a class, and by its concentration into the hands of certain corporations within the class. The proportion of primary power from all sources and for all uses, controlled by public-service corporations, rose from 11 per cent in 1902 to 24 per cent in 1912, more than doubling in the 10 years. This movement toward concentration is found in all sections of the United States. For the 10 years, 1902 to 1912, the rate of concentration was highest in the South Atlantic States; the extent of concentration was greatest in the Western States. In the three years since 1912 there has been a still more rapid increase in the rate of concentration in all sections, and particularly in the Western or public-land States. While slightly over 50 per cent of the total primary power of these States was controlled by public-service corporations in 1912, the percentage has risen to 90 in the three years since that date.

If inquiry is made into the control by certain corporations, it will be found that 18 public-service corporations control either by ownership of properties, majority ownership of stock, lease or direct mangagement, one-half of the total developed water power of the United States employed in public-service operations; that nine of these control more than one-third of the total, and six more than one-fourth.

We are faced to-day, then, with a water-power development of about 6,000,000 horsepower; with a development in the public-service electrical industry alone, from all sources of power, of not less than 15,000,000 horsepower; investments of from $2,000,000,000 to $3,000,000,000, and a rapidly increasing concentration in its ownership and control; and with a Federal law governing the disposition of power sites on the public lands unchanged since the electric industry was in its infancy, giving no greater security to the investment than a revokable license, and depending, for the protection of the public interest involved, solely upon the wisdom and discretion of an executive officer. For the better protection of the hundreds of millions of dollars already invested on the public lands, and for the purpose of giving permanency by legislation to the policies which have been wrought out of the experiences of administration, either the present law should be amended or a new law enacted.

If favorable power sites were unlimited in number, and if the business of the development, transmission, distribution, and sale of electric power did not constitute a natural monopoly, there might be little occasion for special legislation with respect to the business, and scarcely more reason for putting restrictions upon or attaching conditions to the use of power sites upon the public lands than are placed upon a homestead or a mineral location. But the ever widening sphere of operations of public-service corporations, the impossibility of depending upon competition as in other lines of business to secure reasonable rates and adequate service, and the realization that such competition as does exist is but the prelude to subsequent consolidation with the all too frequent accompaniment of inflated valuation and excessive capitalization have forced public opinion into the acceptance of the principle of regulated monopoly in public-service operations.

Consolidation of operating plants within the limits of economical transmission has distinct advantages. By operating the combined system as a single unit instead of a series of independent units, the capital investment will be reduced; by having many plants instead of one plant, accidents will not result in serious



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interruptions to service; and by serving a large market with consequent diversity in time and character of demand, a fuller utilization of the equipment may be made. For all of these reasons consolidation of operating plants into a single unified system reduces the financial risk and lessens the cost of the product. But the compelling motive in such consolidation and in the monopolization of the market is not public service but private profit. The situation is accepted by the public only because it is realized that in such a course are the possibilities of better service and lower rates; yet it is equally well realized that to secure these benefits nothing short of complete public control is sufficient.

Over and above the mere economic questions of rates and service, the ever-increasing concentration in the ownership and control of the public-service business presents political and social questions of grave concern. Notwithstanding adequacy of the service and reasonableness of the rates, are we approaching the time when the entire conduct of public-service operations and the initiation of every new enterprise is to be left entirely in the hands of the few? This is the question which the near future will be called upon to answer. While the highest public interest requires that full protection and adequate returns should be accorded to all honest investment in the public service, yet if we are to be prepared to meet the issues of the immediate future it is imperative that no public rights be surrendered and that all agencies, both State and national, shall act in harmony.

The movement toward active, effective State regulation dates back to the New York and Wisconsin laws of 1907—only eight years ago. Since that date many other States have passed similar laws, until to-day a majority of them exercise some measure of control over the operations of public-service corporations. The net result of that State legislation which has carried regulation the farthest is to make public-service corporations quasi agents of the State. Along with limitations upon the freedom of action of these corporations and upon their rate of profit has gone also, in large degree, the elimination of financial risk.

In the regulation of the public-service business States must act through their sovereign powers, save in those comparatively few instances where the use of State lands is involved. The Federal Government, on the other hand, because it holds the title to the public lands, has all the powers of a proprietor, and it is through its proprietary powers and its right to put conditions upon the disposition and use of the public lands that it can most effectively supplement the action of the State.

Far too often in the past the title to public lands of great value for power development has been acquired, not for present use, but for future sale at prices to be determined by the necessities of the real user. No longer, however, can public lands be acquired for such a purpose. Yet only the proprietor has the power to prevent it. To regulate the occupation and use of the public lands, to require prompt and complete development of the power sites thereon, and to prevent the withholding of such sites from use for purposes of speculation, is one of the functions of the Federal Government.

The failure to regulate rates and service to-day does not prevent the full exercise of the power to-morrow, for such power is an attribute of sovereignty that can not be lost through mere neglect; but if the proprietor's title is allowed to pass, either with or without compensation, the proprietor can not recover it, and the sovereign can not retake it save for a public use or, regardless of original cost, value it for purposes of rate making or of purchase at anything less than its present value to the user. If the enormous excesses of present land values over original costs, which are constantly brought for-

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ward in valuation proceedings in other lines of public-service operations, are to be eliminated from any part of the electric-power business, title to the public power sites must be retained by the public, and grants must be in such a form that land values in excess of cost shall be eliminated. Since none but the proprietor can do this, the most important function of the Federal Government in the regulation and control of power development is its power as a proprietor to fix the conditions under which power sites upon the public lands may be used and the values that may be set up in connection with that use. Capitalization of land values in public-service operations is the problem most urgently needing attention. Upon its satisfactory solution will depend whether the public-service operations of the future are to be conducted by private or by public capital.

Of all the elements that enter into the cost of a power system, the only one that can be altered by legislation is the cost of capital. To secure cheap capital and to reduce the investment to a point where favorable rates may be granted, it is necessary to protect the investment and to provide conditions under which reasonable returns may be assured. Certainty of tenure for a period sufficiently long to realize the expected profits upon an enterprise is one of the prime requisites of cheap capital. The main defect in the existing law is its apparent uncertainty of tenure, but certainty of tenure requires neither a patent nor a perpetual grant. All the protection that capital needs, all the capital that development requires, can be secured under long-term leases, accompanied by reasonable conditions of occupancy, without any sacrifice of the public interest.

Since the public lands of the United States are not subject to condemnation, except upon the approval of Congress, it is to be presumed that permanent structures placed thereon are likewise not subject to condemnation. In some of our States, particularly the Western States, municipalities have the power to condemn public-service properties for their own use. To allow municipalities to secure title to properties upon the public lands with the same facility that they can secure them upon private lands, and to prevent the owners of properties which a municipality might wish to acquire from obtaining by occupancy of the public lands immunities not possible upon private lands, every lease granted for public service use should contain the reserved right of public recapture of such properties upon the termination of the lease upon the return to the lessee of his actual and legitimate investment, less depreciation paid out of earnings and sinking funds accruing from earnings.

Under no circumstances should the power sites which will be needed for future use in the public service be allowed to pass from public ownership; nor, on the other hand, should large areas be withdrawn from other uses because of the mere possibility of future power use. If complete withdrawal is limited to sites under lease or application for lease and to those which are primarily and immediately valuable for power use, the use of the remainder for other purposes can be provided for and their future use for power development can be protected by making in any patent issued a reservation of the power use of such lands perpetually and exclusively in the United States or its lessees upon the payment to the patentee of reasonable compensation for improvements, but of no site value.

A lease is a form of contract into which no would-be lessee need enter save at his own option. Into such contract may be written all the requirements that appear to be necessary for the full protection of the public interest. No rights of corporations or of individuals would be traversed thereby, for none are obligated to accept unless they wish. The only consideration that need govern

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is whether the proposed conditions are such that sufficient capital may be attracted to the business to insure the maintenance of an adequate power supply.

Prompt and complete development and continuous use of power sites upon the public lands, limitation of valuations to reasonable cost for both rate making and public purchase, protection of the investment by certainty of tenure and reasonable conditions of occupancy, recapture of the properties for public use at the termination of the lease, and a reservation of power rights in all lands suitable for power use should be the cardinal principles of a water-power policy for the public lands of the United States. In carrying out such principles there is no duplication of the functions of the several States, only the exercise of powers which the States do not possess. In performing these functions the Federal Government would act as a proprietor, not as a sovereign; would supplement, not supersede, the State.

The CHAIRMAN. Mr. Merrill's paper is now open for discussion.

Mr. LEIGHTON. I do not wish to be understood as opposing public regulations, for I recognize that it is the only instrument that can be used to satisfy the public and to protect the public interest in all cases. Personally I do not find fault with any of the regulations set down by the Interior Department. There are some regulations which I believe are not sufficiently definite, but after all they are of secondary importance.

The facts are that the water-power site, the water-power development on the public land, on the navigable streams, or wheresoever it may be located, under public regulation must compete for money at all times with other investments and other securities.

I think it may be well for those of us who become enthusiastic over the prospect of having water-power plants on navigable streams, as on public lands, developed under lease and under permit, to remember that unless those conditions and the returns, the rewards of industry, can be made to compete with the returns and rewards of industry in other lines of investment, we will within a few years have to look to Government funds and Government development and, possibly, a Government operation.

To-day there are more than 6,500 fine, gilt-edged securities for sale in the open market over which there is not one shred of public control. These shares are very profitable. Now, why will the naturally selfish human being go out of his way to purchase public-utility securities that are regulated? I think that is a very pertinent question, and one that will have to be answered pretty soon.

Mr. E. C. FINNEY. Mr. Chairman, I believe we must offer to investors some security for the money invested; we must give them a definite tenure and assurance that they will be able to secure the return of their investment with a fair rate of interest, or, of course, they will not invest their money in water-power enterprises. But I think that is equally true of industrials; that is to say, the investor

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hopes at least ultimately to secure the return of his principle with interest upon the money invested. With water power, however, development control by the National or Federal Government, particularly if such control and regulation extends to the issuance of stocks and bonds and so regulates the enterprise that it is not overcapitalized, will insure a large measure of security attractive to the investor. We have cases where operations not so controlled have watered stock, and have so conducted their business as to deprive investors not only of returns but of a large part of their principal invested. It seems to me that this water-power development is a national question and is not confined to State lines. The developers are not the only ones interested in the development; the whole general public is interested; and as the uses of the power and the transmission distances increase, the public will become more and more interested in this development, and if so interested I think that they will be willing to extend to those who put their time and money into development in electrical enterprises a reasonable return and a reasonable security, so as to induce this development.

Mr. JOHN H. FINNEY. Mr. Chairman, may I ask what percentage Mr. Merrill said was in use by the public utilities in the United States?

Mr. MERRILL. Three-quarters.

Mr. JOHN H. FINNEY. Three-quarters of the developed power. But you will find the water power so used is almost always coupled with and made useful by a steam plant. Aside from Niagara Falls and one or two others there is hardly a water power in use in the United States by a public utility that is not necessarily coupled with the development of a steam plant, and frequently that steam plant is almost as large and sometimes larger than the water power itself, made necessary by the fact that failures of water and failures of transmission lines absolutely require a steam plant to take on the load at critical times. It is an assurance which the public utility that uses water power must have.

I believe that a reasonable amount of water power in the United States is to be developed in the next 50 years for public utility use, but only a reasonable amount, partly due to the fact that the length of transmission lines increases the risk of failure as we get away from the center of distribution, and we can expect only a very moderate amount of the large amount of water power in the United States to be developed for public use in connection with public-service operation.

The largest use of water power, therefore, and particularly as it relates to the remote water powers of the United States, is to come from what might be termed a private use, and that private

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use comprises some of the things that are almost public. It is to come in large measure from the irrigation of arid lands, through the pumping of water onto the higher levels. We have almost reached the limit of irrigation as applied by gravity systems. It has to come from the use of electric power in the driving of motors, pumps for the dewatering of swamp lands; it has to come from the electrification of steam railroads; and the largest use of all is to come from the establishment of privately owned, privately built electrochemical and electrometallurgical operations.

The foundation for the large use of water power in the United States is permanency of use; not a 50-year limitation, not even a 100-year limitation, but permanency of use. I think the point is often missed that the permanency of use does not mean rights in perpetuity, because there is not a water power in the United States developed or that can be developed that is not wholly at the service of the United States whenever the United States wants to acquire it, as it would acquire any other property, by purchase.

When the United States builds a dam on a navigable stream to improve navigation it does not build it for 50 years, with the idea that at the end of 50 years it is going to get out of the stream. It is there permanently. It is serving a useful purpose. Now, if we can get into our minds that while the agency of the operation may change, due to changed conditions in the national life and to the necessity perhaps of the United States acquiring the water rights by purchase at the end of 50 or 100 years, or whenever necessary—and that is certainly the right way to get property; it should not be purchased for less than its value—private capital can be attracted to water-power developments.

Water power is not always cheap power. It frequently costs, owing to its larger capital charge, more than steam power generated at the point of distribution. That is not true, of course, in the West, where coal is scarce and high, accounting for the remarkable development of water power in that section. The cheapest commodity in the United States is electric power. I do not know anything else that has not gone up, systematically gone up, in price over a period of many years. The more of it we have I think the better off we are, because the measure of its value is not so much the small lighting that we use, or the power we use for the small electric fan or the quantity of electricity we use for our electric irons in the home, as in its wide use for manufacturing purposes, where the kilowatt of energy, costing say $20 or $25 a horsepower a year, puts in the National Treasury a thousand or more dollars worth of manufactured products. Those manufacturing operations are going to mean the largest development of water power in the United States. We talk about 30,000,000 or

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60,000,000 horsepower in the United States. It must have been 30,000,000 horsepower 10 years ago, but I believe that figure is very materially reduced by our lack of development and by the improvements in the steam plants and economies effected by the big steam turbines, which have actually put out of the market, out of the possibility of development, a very large amount of water power that 10 years ago or 5 years ago could have been commercially developed at a profit.

Mr. WILLIAM MCCLELLAND. Mr. Chairman, the fundamental consideration of this subject is whether this country at large wants private capital to develop its water power. I assume it needs no proof that the real definition of the conservation of use of resources is in not saving them but in developing them. The fundamental question, therefore, is whether the country wants to provide capital to do it or whether for some reason it would prefer to have it done by National or State Government.

I have heard the word sovereignty used a great deal, the sovereignty of the State or of the National Government, but if there is any sovereignty in the world it is that of capital, which is the result of the savings of the individual and the only possible way to get real capital. And that is the distinction, of course, between capital and the resources which have been given to us by nature.

Imagine for a moment capital, the original investor, and which incidentally you are trying to protect—imagine capital standing facing this situation and saying: "I can invest here or there or somewhere else." It will surely ask, "What is the reason of these particular investments?" There are the same risks in water-power developments as in other commercial enterprises as commercial ventures. We are concerned here with other risks that are in addition to the ordinary commercial risks that must be met by capital.

Coming back to our subject of this morning, if the Government will cease to protect its proprietary interests in this land, assuring that a fair return is made to capital invested, and granting that the public utility corporation is an agent of the State, I do not think there will be any quarrel at all between investors and the Government. I think a law could be quickly agreed upon, whether the title be given by lease or whether it be given by some other form. The difficulty enters when you come to discuss the particular terms. That is a reason, gentlemen, why I can not disagree with many points that have been raised in the paper. I don't care whether it is a permit or a lease, provided that a man who invests knows that he may be allowed to develop it. The paper itself acknowledges that in many cases there is very little market, and therefore it is agreed at the start in the paper that perhaps the man who attempts to develop the

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water power has to develop the market. Surely a period of 50 years is a remarkably short time for that; and then, again, you have to face this point, 50 years is a long time as measured by a man's life. It is very difficult, therefore, in these days to get a group of five men to put several million dollars into an enterprise on the basis of a term of 50 years. If, then, development and a margin of profit can only come about in this way, it seems to me that if the National Government wants to invite capital to come in and develop these resources, then taking these very acceptable general principles stated, it must be willing to put them in specific terms which will be accepted.

The investor must be granted permanent use. Then if the Government will say, if you meet certain stipulations we will grant you indefinite use and we will see to it that as far as possible you will have a fair return on your money as measured by your risk, and if at any time we want to take that land for public use and must have it, we will pay you all that it is worth, stipulating that accurate records be kept of everything that is done, I can not see how any business man could object. Now, I do not think permanency alone is going to attract capital. On top of this comes the inquiry, Is capital going to get any return, or is some one going to come in 10 years from now and say that 6 per cent is enough, and refuse positively to give any reward at all for the initiative, for the energy, for the tremendous expenditure of time and money necessary to bring this idea to a fruition? There is tremendous risk. It is becoming increasingly difficult to get private capital for public utility use except in cases where private capital is given full security for its investment.

I do not think it would be difficult for a great corporation to extend its capitalization by the issue of a bond with mortgage on existing property, so that the owner of these bonds can fairly say, "Well, if the Government ever does take over this enterprise, or if there is any regulation we will get the value of our bonds, of course." That kind of expansion is not what I am talking about. That kind of expansion would never have developed the United States, will never develop the South American States or any district where the conditions are of the pioneer sort. In other words, it will never create development. If we are going to interest private capital in this enterprise, it will only come in as it sees fit. The first thing to do is to so arrange that its construction and title conditions will be such as to insure permanency, and then perhaps we can find out whether capital, in viewing these risks of regulation, in spite of this permanency, will come in.

Mr. TORCHIO. Emphasis is placed on the regulation of public utilities. Water-power development has nothing necessarily to do with public utilities. The public will require electric light and

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power. Electric light and power will be supplied regardless of water power. The regulation of public utilities has nothing to do with water-power development. Public utilities will use whatever power they may, either from the energies that nature gives them—oil, coal, and other sources—or water power if they can obtain it. It is only a question of economics, pure and simple. They will adopt water power in preference to other power if it is more economical to do so. They can get the market, they can get the monopoly, with other means; the water power is not essential.

The capitalist has only to compare the cost of developing and securing water power from water falls with that of getting power from coal, oil, or other substance.

Now, in developing a water-power plant, the capitalist can arrange to use steam power at the place or he can make an effort to get water power from some distant point. The fundamental fact must be recognized that to-day in the total cost of power we must include the cost of operation and the cost of the investment. Let us speak from the investment standpoint. It is recognized that per unit of horsepower or kilowatt the cost of installation, the development cost, i. e., the initial cost is greater for water-power development than for steam power. Therefore the interest charges on the investment are greater for water-power development than for a steam plant. Further, in the case of water there is usually a long transmission line to install that would not be required by the steam plant. That transmission line, its cost, interests and depreciation, the maintenance cost, is a charge on the debit side of the water power plant, and it is an extra cost.

With respect to operation, if we consider the generating station, the modern electric equipment of a steam or power plant, the cost of labor, etc., we might say the station cost of maintenance would be about equal, with the exception of the item of coal consumed by the steam plant. Therefore the essential point in favor of the water-power plant is, in the ultimate analysis, the difference in the cost of coal. This will depend upon how much use you make of a certain power, how much saving you will make in the amount of coal consumed. The average use of power in city industries in general is one-third of the time that it could be used if it were used all the time. In some rare cases we may have what we call a load factor of 38 to 40 per cent. Therefore for 8,760 hours in a year we may use the power only 3,000 hours or less. If we have a steam plant we have to generate steam and produce energy and consume, say, a pound or 2 pounds of coal a kilowatt-hour for 3,000 hours. That is the average use of utilization of service throughout the country.

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To make the best use of the water power you must use it more or less continuously, because if you use it continuously instead of one-third of the time, instead of 2 pounds of coal per kilowatt for 3,000 hours you will use, say, 2 pounds of coal for 8,760 hours.

When water-power plants, therefore, are to be utilized by public-utility corporations they must utilize these water-power plants for a long period of time and must supplement the water-power development by a steam plant.

One reason for this kind of ownership is the necessity of the users of these companies to take advantage of the diversity of the demand from different customers. By such diversity they can use their water-power plants to the greatest advantage, using a load factor as high as 66 per cent.

In conclusion I wish to state that the problem of water-power developments in this country hinges exclusively on the cost of coal in a certain locality. If the cost of coal is not large, there would be very little inducement for water-power development unless that water power can be used for certain specific purposes or chemical processes. Now the problem of development by electrochemical processes is a serious one. You can not develop this process unless you have the material for operation. The transportation charges are also to be considered.

The financial people of this country are trying to see if they have some reasonable advantage in development. It is not the only source of power for them to use. They can use other powers. They can develop their own steam plant, and they can not fear any competition from water-power plants on operation of 35 per cent load factor. Recognizing these facts, I think that legislation should be based upon some very liberal point of view as outlined by some of the speakers this morning.

Mr. MERRILL. I am glad to have had Mr. Leighton and Mr. McClelland reinforce the statement I wished to emphasize in my own paper, that the only criterion of adjustment as to whether the legislation or administrative policy is correct or incorrect is whether it permits enough capital to enter the business to give us the supply that is needed. That is not a question that can be determined by rule of thumb.

We find that for the electric-power industry as a whole in the United States, according to the Census Bureau in 1912, the payment on the bonded debt was 4.52 per cent, the average interest on the bonded debt. And after the payment of all expenses of every kind, operating expenses, interest on the bonded and floating debt, depreciation, sinking fund, insurance, and so forth, there was enough

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surplus left over to pay 5.6 per cent dividends on every dollar, on the principal of the outstanding capital stock, both common and preferred.

We may take as an example of the effect of what has occurred under both Government and State regulation, the State of California. More power is developed on the public lands, a greater proportion of power is developed on the public land in California today than in any other State of the Union. There is a more stringent regulation by the State commission in California than in any other State. And yet in the year 1914 California had an electric-power development of 1,000,000 horsepower. The individual peak demands were 700,000 horsepower. Presumably it is fair to say that the simultaneous peak over the entire group has not exceeded 600,000 horsepower. This means in California in 1914 there was an excess of installation over the peak's demand for the year, 400,000 horsepower.

Now, a certain margin of course is necessary to meet the extension of markets, to take care of conditions of accidents on the line, but no engineer would contend that 400,000 horsepower is necessary on the top of 600,000 horsepower. In the State of California, then, where we have the most extensive Federal regulation and the most stringent State regulation, there is at the present time far more power on the wheels than those who develop it know what to do with or can dispose of.

Now, with respect to one other matter brought up. The lease which has been advocated for 50 years is not to terminate at the end of 50 years, except under one condition—when the property is to be taken over and the investment returned. Otherwise the leases would be renewable and the property would continue in operation. If the man's investment is returned after he has had the use of it for 50 years, he can scarcely contend that it will deter the investment of capital in the enterprise.

We see everywhere hundreds of millions of dollars invested in street railways. They get no perpetual franchise; they do not get even 50 years. Time after time those investments are made on 25-year grants.

In respect to the industrial use of water power the question I have presented here this morning has referred only to public-utility use. I would not apply the same rules to industrial use. I would not grant more than a lease, because I believe a lease is all that is required, but I would not make the property subject to recapture at the end of the period, nor would I apply other conditions that are applicable to public-utility use until the properties or the plant changed from its industrial to a public-utility use.

The CHAIRMAN. We will have to proceed now to the following paper, by Mr. M. O. Leighton, of Washington, D. C.:

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# THE WATER POWER RESOURCES OF THE UNITED STATES.

By M. O. LEIGHTON,

*Consulting Engineer, Washington, D. C.*

The capacity of the water-power sites in any region can not be stated in concise terms. Many qualifications and explanations must accompany every quantitative statement. Into any such estimate many factors besides flow of water and available head must be introduced. It is probable that no two persons working independently on the same data would finally report figures in close agreement.

The first question that arises is whether the estimates of water-power resources of any region relate to present or to future practicability. If they relate to the present, they will fall short of the actual power capacity that will be available in the future. Our ideas of practicability of water-power privileges change rapidly. This is due in part to improvements in power appliances and increasing adaptability of hydroelectric appliances. Many water-power sites which, 10 years ago, were regarded as excellent, are to-day not practicable because of the astonishing advances that have been made in steam production and utilization. In other words, they can no longer compete with steam power. Our ideas also change according to the demand for power. A development that would be too expensive to-day may be a live proposition 10 years hence. A water-power privilege is something that is clearly revealed only after mature study. Such study is impossible in the making of a power estimate covering a large region like the United States. It is certain that many streams which, in a rapid survey, would be passed over as nonproductive, would show very good power privileges when subjected to considerate examination. The converse of this is equally true. For example, certain streams in the United States were omitted from consideration by the United States Geological Survey in its power report of 1908. Some of these streams have since been found to possess very good power resources. Other streams that were credited with power values have been found to have little or no power value.

On the other hand, if the estimate of water-power resources is designed to cover future practicability, large errors are inevitable because we can not even imagine what hydroelectric science may produce in the future. For example, the estimate of the United States Geological Survey in 1908 was made on the basis of 90 per cent efficiency on the wheel shaft, and the report emphasized the fact that this was a future achievement. The Commissioner of Corporations in his report on water-power development in the United States, published in 1912, rejected this efficiency because of his belief that it could never be attained. Now, only three years after the publication of the latter report, we have become familiar with turbine efficiencies largely in excess of 90 per cent.

The second question that arises in the making of any water-power estimate is whether the figures represent the power output on the wheel shaft, the generator, the transformer, the substation, or whether it represents the amount that the consumers, located miles away from the power site, may actually utilize. Of course, the amount of power made available to the actual consumer is the figure which finally determines the water-power resources of any region. Yet, here again we encounter many variables and we have always to recognize the future possibilities of hydroelectric science. Is the "headrace-to-consumer" efficiency going to be 50 per cent or 90 per cent? If we may take the efficiency history of the hydraulic motor as an index, we may not be overoptimistic in selecting 90 per cent.

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There are many other variable factors of which the bounds of this paper will not permit description. For the sake of simplicity, the writer, in presenting this estimate, has made the following assumption:

(*a*) Practically all the rivers included in the present estimate have a slope of 10 feet per mile or in excess thereof.

(*b*) The available fall is reduced 15 per cent.

(*c*) The figures represent power on the wheel shaft, assuming a wheel efficiency of 90 per cent.

The results derived on the foregoing basis are almost certainly inaccurate with respect to any particular site or designated stretch of river channel. We may be confident that these individual errors will compensate each other in some degree. With respect to present or future practicability, the writer has taken the same position as that adopted by the Geological Survey in 1908, viz:[1]

For the purposes of this report, it has been assumed that all the power in the United States will some day be required * * * the schedule here presented must be interpreted for the future rather than the present. The reader should not assume that all the power shown here is economically available today. Much of it, indeed, would be too costly in development to render it of commercial importance under the present conditions of market and the price of fuel power. The schedule shows, therefore, what will be the maximum possibilities in the day when our fuel shall have become so exhausted that the price thereof for production of power is prohibitive and the people of the country shall be driven to the use of all the water power that can reasonably be produced by the streams.

Two sets of figures are given below. The first represents minimum or primary horsepower. These estimates are based on the minimum flow for the grand average of the lowest two consecutive 7-day periods in each year of record. The second represents assumed maximum development, or it may be called the overdevelopment, producing secondary horsepower—i. e., power available during only a part of the year. During the past few years much of that which we formerly considered as secondary horsepower has really become primary horsepower. Secondary horsepower is of little value when distibuted directly from a single isolated water-power plant, but under the modern practice of tying a large number of power plants on different drainage areas into a single distribution system and utilizing to good advantage the diversity of power consumption that is found among a large number of consumers, a very important part of the so-called secondary horsepower can and is being worked into primary use. This, by the way, is one of the strongest economic advantages of water-power consolidation and regional monopoly in service. When, eight years ago, the United States Geological Survey put forth its estimates of assumed maximum development based on the lowest stream flow that can be assured during the six high-water months of the year, it was the opinion of many that these six months should be increased to nine months. The advantages of combination and of diversity of use above described have made it certain that at the present time the six months' period is not too small and it would not be surprising if, in future estimates, even this period would be considerably reduced.

The base data upon which the following figures are based were taken from Water Supply Paper No. 234 of the United States Geological Survey and the Report of the Commissioner of Corporations on Water Power Development in the United States, 1912. These data have been subjected to modification in conformity with the specifications above given.

[1] U. S. Geological Survey Water Supply Paper 234, p. 47.

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*Potential water power in the United States.*

| | Minimum. | Assumed maximum. |
|---|---|---|
| United States | 31,843,300 | 59,678,800 |
| North Atlantic States: | | |
| Maine | 513,000 | 916,000 |
| New Hampshire | 153,000 | 279,000 |
| Vermont | 107,000 | 195,000 |
| Massachusetts | 134,000 | 258,000 |
| Rhode Island | 6,600 | 15,100 |
| Connecticut | 81,000 | 155,000 |
| New York | 2,642,000 | 3,322,000 |
| New Jersey | 50,000 | 120,000 |
| Pennsylvania | 313,000 | 776,000 |
| South Atlantic States: | | |
| Delaware | 5,700 | 12,300 |
| Maryland | 48,200 | 138,000 |
| District of Columbia | 5,700 | 12,300 |
| Virginia | 554,000 | 987,000 |
| West Virginia | 432,000 | 1,190,000 |
| North Carolina | 655,000 | 992,000 |
| South Carolina | 522,000 | 768,000 |
| Georgia | 424,000 | 710,000 |
| Florida | 8,500 | 15,100 |
| North Central States: | | |
| Ohio | 67,000 | 202,000 |
| Indiana | 49,000 | 133,000 |
| Illinois | 217,000 | 391,000 |
| Michigan | 204,000 | 332,000 |
| Wisconsin | 406,000 | 760,000 |
| Minnesota | 263,000 | 560,000 |
| Iowa | 161,000 | 433,000 |
| Missouri | 81,000 | 184,000 |
| North Dakota | 99,000 | 234,000 |
| South Dakota | 48,000 | 85,000 |
| Nebraska | 222,000 | 415,000 |
| Kansas | 126,000 | 305,000 |
| South Central States: | | |
| Kentucky | 93,000 | 223,000 |
| Tennessee | 522,000 | 864,000 |
| Alabama | 577,000 | 1,070,000 |
| Mississippi | 36,000 | 71,000 |
| Louisiana | 1,000 | 2,000 |
| Arkansas | 24,600 | 69,000 |
| Oklahoma | 85,000 | 237,000 |
| Texas | 239,000 | 624,000 |
| Western States: | | |
| Montana | 3,170,000 | 4,905,000 |
| Idaho | 1,317,000 | 2,906,000 |
| Wyoming | 876,000 | 1,480,000 |
| Colorado | 954,000 | 1,924,000 |
| New Mexico | 181,000 | 498,000 |
| Arizona | 1,010,000 | 1,925,000 |
| Utah | 843,000 | 1,493,000 |
| Nevada | 194,000 | 313,000 |
| Washington | 5,603,000 | 9,810,000 |
| Oregon | 3,570,000 | 7,500,000 |
| California | 3,880,000 | 8,870,000 |
| SUMMARY. | | |
| North Atlantic States | 3,999,600 | 6,036,100 |
| South Atlantic States | 2,655,100 | 4,824,700 |
| North Central States | 1,963,000 | 4,034,000 |
| South Central States | 1,627,600 | 3,160,000 |
| Western States | 21,598,000 | 41,624,000 |

DEVELOPED WATER POWERS.

A concise statement of the capacity of developed water power is as difficult as is that of undeveloped power. Besides all the uncertainties with respect to the point of measurement it is also necessary to distinguish between the installed wheel capacity and the amount of power actually produced at the season of minimum flow; in other words, whether the statements refer to power units installed or primary power available.

The figures given herein refer generally to installed wheel capacity. It should be remembered that the results are greater than the power actually

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available to the consumer. No water-power plants are included of capacity less than 1,000 horsepower, except in cases where such plants are tied into a transmission system along with larger plants.

The figures here given combine "commercial power" and "manufacturing power"—i. e., power sold from central stations for miscellaneous service, such as lighting, manufacturing, transportation, etc., and power developed by manufacturing concerns and used by them solely for manufacturing purposes. Although these purely industrial powers constitute a fairly large percentage of the total (about 35 per cent) there is little new development of this kind and the relative importance of such installations will constantly decrease in the future. One of the modern economic necessities in hydroelectric service is "diversity of use"—i. e., the delivery of power to many different kinds of consumers all tied into a transmission system so that the "peak load" of each consumer shall, so far as may be possible, occur at a time of day different from that of every other consumer. Under such conditions the base load on any system is made more steady and the system peak load becomes less pronounced. Hydroelectric systems are so high in first cost and transmission systems, whether supplied from fuel or from water-power plants, are so expensive in both first cost and in maintenance and operation that it has become necessary to keep the plant in service and thereby to derive income from service rendered throughout the entire 24 hours of each day. So it is that during the past 10 years power production and delivery has become a business in itself, entirely separate from the business that utilizes the power. Hundreds of manufacturing plants and many electric railroad lines which formerly produced their own power have within recent years abandoned their prime movers and have tied into a general distribution system along with other consumers. Thus it is that in our legislative and administrative preparations for future control of water-power development we need give little consideration to the purely manufacturing development.

A census of developed water powers was made by the Census Bureau in 1908 in connection with the investigations of the National Conservation Commission. An aggregate of 5,856,680 developed horsepower was reported. This figure included all plants of whatsoever size concerning which knowledge of location or existence could be secured by the Census Bureau through correspondence with the postmasters of the United States in the first instance and by direct inquiry of the proprietors of the plants in the second instance.

The Commissioner of Corporations, in his report on Water-Power Development in the United States, 1912, reported 4,016,127 horsepower, of which 2,961,549 horsepower was classed as commercial and 1,054,578 horsepower as manufacturing. These totals included, as a rule, only those plants of 1,000 horsepower and more. It was estimated in this report that the aggregate capacity of plants of less than 1,000 horsepower was about 2,000,000 horsepower, making a total for the United States, in round numbers, of 6,000,000 developed horsepower.

In the census report of 1912 on Central Light and Power Stations there is given a total of 2,471,081 water horsepower. This figure does not include the water-power plants used solely for manufacturing purposes and therefore the data are necessarily incomplete as to total water-power developments in the country.

The following estimate reported by the writer is based in part on the figures given—(*a*) in the report of the Commissioner of Corporations above referred

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to; (*b*) by the United States Forest Service with respect to the 13 Western States; (*c*) from figures concerning individual plants not included in the two foregoing reports secured by the writer from current engineering journals, from statistical departments of operating companies, and from many engineers familiar with the subject. We are safe in assuming that these figures are not entirely correct. It is probable that the reports from many plants are not based on the actual turbine capacity, but on the generator output. On the other hand, it is quite as probable that there are many instances of overstated turbine capacity, due to the fact that plants are not operating up to the efficiency acquired in the original wheel tests. It is further probable that some of the more recent developments are omitted from the estimate. Some of the figures included in the table relate to power in process of development—i. e., developments which have a moral certainty of completion and operation in the immediate future. Care has been taken, however, to eliminate merely prospective developments and also those which may have proceeded to the point of final design, but which have not yet been financed.

The total power development in the United States, excluding plants of less than 1,000-horsepower capacity, as above explained, is, in round numbers, 4,600,000 horsepower. The data are given by States in the following table:

*Capacity of developed water powers in the United States.*

| | Capacity, horsepower. | | Capacity, horsepower. |
|---|---|---|---|
| Alabama | 86,450 | Nevada | 10,660 |
| Arizona | 27,890 | New Hampshire | 120,108 |
| Arkansas | 0 | New Jersey | 7,200 |
| California | 601,425 | New Mexico | 0 |
| Colorado | 69,965 | New York | 715,500 |
| Connecticut | 60,250 | North Carolina | 91,200 |
| Delaware | 0 | North Dakota | 0 |
| District of Columbia | 0 | Ohio | 4,025 |
| Florida | 5,000 | Oklahoma | 0 |
| Georgia | 173,427 | Oregon | 76,120 |
| Idaho | 116,415 | Pennsylvania | 169,632 |
| Illinois | 65,450 | Rhode Island | 0 |
| Indiana | 14,870 | South Carolina | 200,497 |
| Iowa | 121,400 | South Dakota | 0 |
| Kansas | 6,800 | Tennessee | 62,000 |
| Kentucky | 0 | Texas | 0 |
| Louisiana | 0 | Utah | 64,950 |
| Maine | 310,450 | Vermont | 97,545 |
| Maryland | 0 | Virginia | 51,820 |
| Massachusetts | 182,220 | Washington | 328,590 |
| Michigan | 133,102 | West Virginia | 21,400 |
| Minnesota | 188,015 | Wisconsin | 205,492 |
| Mississippi | 0 | Wyoming | 0 |
| Missouri | 18,000 | | |
| Montana | 238,400 | Total | 4,640,208 |
| Nebraska | 0 | | |

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# COORDINATION IN THE DEVELOPMENT OF OUR WATER POWER RESOURCES WITH OTHER USES OF WATER.

By M. O. LEIGHTON,
*Consulting Engineer, Washington, D. C.*

During the Sixty-third Congress of the United States there was favorably reported to the Senate a certain legislative proposal providing for the development of water power on the navigable rivers of the Nation. Among the many excellent features of this bill there was one which apparently attracted little attention, but which contained wihin itself the most concise and most comprehensive declaration of a great and necessary national policy with respect to water-power resources that the writer has seen formulated in a legislative measure. The provision is as follows:

> The plans, specifications, and location for any dam shall be such as in the judgment of the Secretary of War shall be best adapted to a comprehensive plan for the improvement of the waterway in question, for the uses of navigation, and for the full development of its water power and for other beneficial public purposes, and best adapted to conserve and utilize in the interests of navigation and water development the water resources of the region.

It would be difficult to compose language in a fashion more significant in its reflection upon past errors and more emphatic in its definition of an enlightened policy.

Rivers can be made to serve many purposes. This is especially true with respect to streams that drain large territories. In such cases the different parts of the drainage area have wide physiographic variation and the water use opportunities vary quite as widely. In the United States, for example, the drainage area of the Mississippi presents almost every physiographic characteristic, from the high, steep, snow-covered mountains to the low and semitropical delta. In one region we may find this river falling down steep slopes and traversing great upland reservoir sites. There the storage and water-power values are predominant. In another region we find the same river entrenched on wide sedimentary bottoms with low slope and sluggish current, and in that region the navigation opportunity is of greatest value. There are other regions where the navigation opportunity combines harmoniously with the water-power opportunity, and still others where the water-power opportunity combines with the irrigation opportunity.

All of the foregoing statements relate to physiographic conditions long familiar. Nevertheless, in our utilization of water resources we have been too strongly persuaded to confine our immediate efforts in any given region to the one purpose that has received the greatest local emphasis. A river can never become a local issue, yet the controlling tendency has been to bend all efforts in one or another single direction, with the result that we have conflicting interests where, in the very nature of things, there should be harmony and undivided effort.

Considered from the economic standpoint alone our rivers are nothing else than huge industrial plants. We can not imagine a successful shoe factory or a pulp and paper mill in which the departments do not coordinate and in which the individual ambitions of each department are not subordinated to the one great purpose, namely, the efficient production of good shoes or good paper. What would such an industrial plant profit from a perfect shipping department if its power department were inefficient? How could such a plant be successful by reason of its first-class finishing department if its purchasing department were incompetent? In like manner our rivers have one economic purpose—to



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supply or to serve the needs and desires of the whole community in the wisest way. The proprietors of a shoe factory are not satisfied with an excellent shipping department if the industry does not produce reasonable profits. The people of the great community known as the Nation who are proprietors of these huge industrial plants known as rivers are likewise looking for and entitled to receive dividends in the shape of public benefits of one or another kind. While the people may be gratified locally at the excellence of the navigation department in one place or the water-power department in another, they may be reasonably sure that, under present conditions and policies, the dividends that they draw from one department are likely to be made at the expense of another department. It is an industrial axiom that such a process can not go on indefinitely without impairment of capital.

Our condition of disorganization with respect to utilization of our water resources was not established by accident or design. A large part of it indeed was inherited. For example, under the Constitution of the United States Congress has control of interstate commerce, and such control includes the uses of our rivers for commercial purposes. The navigation features of any river are paramount, and if the Federal Government chooses to do so it could establish and maintain control for navigation of all streams even to the ultimate sources. Such of our rivers as have not been controlled by the Federal Government for the paramount purpose of navigation are exempt therefrom only by neglect or design of the Government. This power to exercise jurisdiction in the paramount interest of navigation persists irrespective of the character of the streams or the particular purposes for which they may be best used. It is a purely artificial jurisdiction which takes no account whatsoever of particular facts. The fact that this jurisdiction has not led to trouble and bitterness all over the country is due to the very wise and temperate judgment exercised by the War Department, its Judge Advocate, and its Corps of Engineers. Having the power to make a stream navigable in law by mere declaration, the War Department has firmly held its own power in check and has made navigability in law conform quite closely to navigability in fact. But the principle is wrong and illogical. Those who exercise control over our navigable streams should be given the authority to act wisely and in accordance with local conditions and circumstances. If the War Department finds that on any navigable stream the navigation values are subordinate to any other values, then that Department should have the authority to exercise discrimination and to subordinate the now paramount right of navigation.

In the arid West, where the greater portion of the lands require irrigation in order that they may be agriculturally productive, the laws of some of the States prescribe a hard and fast order of precedence in the use of the river waters. We have, for example, written into law, the administration of which is made mandatory, the rule that in all cases and under whatsoever circumstances the preferred use of water shall be that of domestic supply, the second preferred, that of irrigation, and the third, that of water-power development. There is no question that, in the broad average, this order of precedence is the just and logical one. Equally there is no question that the water-power values vested in many rivers are far and away more important than the domestic supply or the irrigation values. The whole question is one of local conditions and circumstances.

The foregoing principles are logical and easy to prescribe, but their application is quite a different matter. In pioneer days, when industry and population are struggling to get a foothold, it is obvious that the broad and comprehensive view here advocated is impracticable. The main purpose is to make

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a start; to get roots into the ground and to establish the community as a going concern. Usually it is necessary to do that which is expedient rather than that which is wise. The history of pioneering shows clearly that it is easier and more purposeful to start something even if wrong and to correct errors after prosperity has been achieved than it is to postpone the beginnings of a country's development until the composite and orderly arrangement of affairs can be provided for. So it is that in the early days of this Nation, and up to a date quite recent, our point of view with respect to our rivers has been sectional rather than national. Now, however, the continental United States is well known. Pioneering as it was known in early times is practically a thing of the past. We have achieved a fairly good idea of our own necessities and may look with comparative confidence into the necessities of the future. Indeed, a change in our attitude has already commenced. The War Department, the Department of the Interior, and the Department of Agriculture, which are most intimately concerned in the rational development of our water resources, have taken some advanced steps to bring about coordination in the development of our water resources. We have therefore made a good start, and the present problem is to determine intelligently upon the details of a course for the future that will contribute most efficiently to the general well-being.

The subject assigned to the writer is coordination in the development of our water-power resources with other uses of water. Within the bounds of this paper it will not be possible to treat the subject in a worthy manner. One might easily indulge in an extended treatise and still omit important features.

### WATER POWER AND NAVIGATION.

Some of the best and most useful improvements in our inland navigable channels have been created by the construction of dams for water-power development. In the majority of such cases such dams are located where natural conditions present obstructions to navigation, such as falls, rapids, or shoals. The treatment of such obstructions by the construction of dams, the slack water behind which will create a navigable depth, constitutes in many places the most satisfactory plan of improvement. Of course, in such plans the dams must be supplied with locks so that vessels may pass from the high to the low level or in the opposite direction. Such a development too frequently involves a greater money expenditure than is justified by the navigation benefits. On the other hand, this type of improvement is the very one which, in large streams, constitutes the principal and most costly item in water-power development.

It is in such cases that, under favorable water-power conditions, the water power created by such a dam is sufficiently valuable to sustain almost the entire burden of cost. So we find in water power and navigation two uses which may ofttimes be coordinated in a way that will promote the public interest in the highest degree. Such coordination may usually be realized with less difficulty and with less interference between conflicting interests than that between any other two water uses. The amount of water required for the lockage of boats is, on streams of any magnitude, relatively small, and although it is true that on certain canalized rivers of the United States the extreme low-water flow is barely in excess of the lockage demands of a busy traffic, it is equally true that such streams do not naturally possess marked water-power values. In other words, entirely aside from their value as commercial channels, they offer little inducement to water-power development unless the low-water flow may be supplemented by water released from storage.

In the United States the sovereign authority of the Government over the improvement of navigation makes it possible for the War Department, in con-

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sidering any water-power proposal on a navigable stream, to provide for the maximum degree of coordination between these two uses. The authority of Congress over our navigable streams is so great that nothing may be constructed therein which does not conform to the coordination principle. The real benefit of a central authority in this case is obvious.

In connection with the water-power navigation uses, it is worthy of note that there is provided a means whereby the country may secure most valuable navigation benefits without expenditure from the United States Treasury for the cost of structures that would otherwise be necessary to create that navigation improvement. In some exceptional cases, it is true, the water-power values are not sufficient to sustain the entire cost of the dam necessary to the improvement of both water-power and navigation. In such cases there must be coordination between the water power developer and the Government, each contributing its just proportion. Such a plan has recently been approved by the War Department with respect to the useful development of the Muscle Shoals of Tennessee River. In more numerous instances, however, the water-power values created are sufficient to sustain all of the cost of the dam and its accessory works. At present, however, there is one great impediment to progress in this direction. The terms imposed by the Government on the development of water power on the navigable streams are so insecure and indefinite that it is only in the most fortunate locations that development capital can be raised. The laws give no security of title whatsoever, guarantee no vested rights, either temporarily or permanently, and actually subject the investments to confiscation. It will be impossible to enter into a discussion of this legal feature of the question as it now exists in the United States. It is significant, however, that out of 81 permits awarded by Congress for the construction of water powers in navigable streams, only 26, or 31 per cent, have been constructed. It is also significant that the majority of those that have been constructed have been unsuccessful from the investment standpoint. Some part of this lack of development and of success in operation is undoubtedly due to other things than lack of investment security, but it ought to be axiomatic that an investment that is purely speculative as to title, security and future disposition can hardly attract the thousands of persons in this country who have and hold the money upon which we must all depend for our public improvements. If there is one class of securities in the investment world which should be stable and be relieved from all speculative elements, it is that security which is based on a permit or franchise issued by the Federal Government. What then shall we say of a law which forces such securities into the speculative class? Our views and our principles concerning the coordination of water power and navigation resources may be ever so enlightened but success can never be achieved until the Government of the United States has assured the honest investor that he shall have full protection of our constitutional guarantees concerning the rights of property. We can not emphasize this idea too strongly. The writer knows of a number of water-power sites in which development would proceed immediately if a plain businesslike contract, mutual in its terms, and satisfactory as to tenure and security of investment, could be secured from the Government. The development of these sites would add 800 miles to the length of the continuously navigable waterways of the United States.

### WATER POWER AND MUNICIPAL WATER SUPPLY.

Coordination between the use of water for power and for municipal supply depends on the physical conditions in each case. The amount of water drawn

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from a great river by a large city would hardly be sufficient to damage appreciably a power privilege lying immediately below the city water supply intake. If, perchance, the sewage of that city is returned to the river at a point still above the power site, then, notwithstanding the fact that a part of the water supply delivered in any city does not reappear in sewage flow, the difference is so small that the effect of the water supply draft on the river is usually negligible. Bear in mind that this statement applies to large rivers like the Mississippi, the Ohio, the Missouri, or the Columbia. If, for example, a valuable water-power privilege were located on the Mississippi, just below the city of St. Louis, and especially if that privilege lay below the point of discharge of the St. Louis sewers, it is apparent that, except in seasons of extreme drought, the draft made by the city on the Mississippi River could not affect the power output. Again, at the city of Louisville, located at the head of rapids on the Ohio River, a power proposition, if contemplated there, would not suffer severely because of the fact that Louisville derives its water supply from the Ohio above the head of the rapids. While there might be some small diminution of available power in times of extreme low water, the fact would not be important in comparison with all the other considerations affecting the feasibility of the power site.

When, in our consideration of this matter, we proceed from large to small streams and especially as we ascend into the mountain streams which, on account of their purity, are generally preferred for city water supply, we enter more and more into a conflict of interest between water power and municipal supply. We encounter streams which, if they could be impounded for water-power purposes, would prove valuable in that line of industry, but which, because of the necessity of holding that stored water to meet the immediate demand of a municipality in time of water scarcity, can not be utilized in a way that will satisfy water-power requirements. In such cases coordination is usually impossible, and, as municipal demands generally constitute the higher use, water power must retire from the field. Passing beyond this class of streams we come to the smaller ones, which, by reason of their limited annual yield, can not be classed as water-power streams except in so far as they may contribute to the larger streams lying below. On the other hand, such streams may frequently be impounded to serve municipal uses in a most satisfactory way.

We have in the United States many instructive instances of water power and municipal supply coordination. In such cases the conduits necessary to bring water to cities may be utilized to develop power in transit. Such instances occur most largely in the western portion of the United States, where the rivers descend from high mountains and where the conduits running from a high country to a lowland city must sustain a high head. Good examples of such coordination occur in the water supply systems of Los Angeles, Cal., and of Seattle, Wash. A similar situation exists with respect to the proposed Hetch Hetchy water supply of the city of San Francisco. Other cities which, in a greater or smaller degree, coordinate water supply with water power are Colorado Springs and Glenwood Springs, Colo.; Salt Lake City and Logan, Utah, and many others. The city of Chicago furnishes an interesting variation of this coordination. For the purpose of securing a pure lake supply Chicago has diverted its sewage into the Chicago River, which formerly was tributary to Lake Michigan. The flow of this stream is now reversed by the construction of a large canal from one of the branches of Chicago River across the divide and into the drainage area of Illinois River. The sewage from the city mains, diluted by a large quantity of lake water and the normal flow of Chicago River,

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is now discharged through this canal. At the end of the canal large water-power works have been constructed. Though the relation between water power and water supply in this case is more remote than in the first cases mentioned, it does nevertheless furnish a striking example of such coordination.

So it is that while the coordination of water power with municipal water supply is in many cases most advantageous, there are many more cases in which it is impossible to achieve this helpful relation. No fixed principles similar to those that exist between water power and navigation can be laid down. The possibility of such coordination must always be determined by a careful survey of the premises in each case and by an appraisal of the relative values.

### WATER POWER AND IRRIGATION.

Coordination between the uses of water for power and for irrigation is sometimes quite simple; under many conditions it may be most perplexing. The satisfactory solution of each local problem depends on local conditions and circumstances. Many engineers and other observers have attempted to lay down certain general pronouncements to the effect that if, in any drainage area, water be used for irrigation, such use will diminish the amount of available water power by given percentages, varying from 40 to 60 per cent. These relations may apply in some cases, but to promulgate them as a general principle in the administration of water resources merely confuses the situation, even as do all general statements with respect to problems that involve many variables.

In many places in the arid West the local conditions are such that the uses of water for power and for irrigation almost perfectly coordinate. We usually find such coordination in those situations in which the developed water-power sites are situated fairly high upstream and above the points at which the irrigation canals divert water from the rivers. If, under such conditions, the amount of water normally flowing in a stream is sufficient for all irrigation purposes and if, at the same time, the demands for power are satisfied by that normal flow, there can usually be no difficulty in the coordination of the two uses. On the other hand, if, as is usually the case, the maximum development of irrigation or of water power requires that stored water be held or be released on a schedule that will best serve the one or the other purpose, then there must be some adjustment as to priority and perfect coordination is impossible. Where irrigation is, as indeed it generally is the preferred use, then the development of water power must be the secondary consideration if the interests of the two are in conflict.

The greatest coordination difficulties are encountered in those cases where the irrigation ditches divert water from the river above the points at which power sites are located. Every cubic foot of water removed from a stream under such conditions for irrigation purposes diminishes by just so much the amount of water power available in that stream. Thus there are many instances in the West in which, by reason of the prior use of water for irrigation purposes, the water-power values have been markedly diminished or actually destroyed. These are the cases in which the attempt to coordinate the two uses becomes most difficult.

As we look over the progress in irrigation and water-power practice during the past few years, we can not fail to be impressed by the fact that this progress is rendering the coordination problem always less difficult. It is adjusting, on a purely constructive basis, opposing interests which have in the past appeared irreconcilable. Bitter contests have been waged between the water-

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power and the irrigation interests, but we are nowadays becoming familiar with coordination between farmers and water-power companies. The writer could cite many occasions in which during the past few years the farmers and the water-power operators have met together during the winter season to discuss and to agree upon operation schedules for irrigation and water power that result in the greatest good to the whole community. The writer knows of one instance in which a power company was, by reason of an accident, reduced to the necessity of shutting down one of its plants on a certain date in the midst of the irrigation season. Actual suspension of operations was prevented by a meeting of farmers who owned rights in a large diversion canal which took water out of the river some distance above this power plant. This meeting advised the power company to proceed with the operation of its plant by taking water to which they, the farmers, were entitled. They said, "We individually can stand the loss, even though it comes in our season of maximum water demand, but to shut down your power plant would mean a great loss to this entire section of the State." So these farmers took only a small part of the water to which they were entitled. All during that season of trouble one could see the lanterns passing to and fro in the cultivated fields at night. These farmers were irrigating 24 hours per day in order that at the small amount of water that they kept for their use could be made to cover as much of the cropped area as possible. What was the result? First, the hydroelectric plant was kept in operation and a great community was assured of its supply of power; second, the farmers themselves confessedly learned many things concerning the economical use of water, and they regard their experience as most instructive and valuable. Successful cooperation of this kind will not die, but its examples will increase from year to year, and thus we shall, within a comparatively short time, find that the coordination of the uses of water for irrigation and for water power will be largely achieved as a result of a better understanding between men. Science will accomplish much, good laws are beneficial, but the greatest advancement will be made by the amicable efforts of conflicting interests which meet together in an informal and mutually helpful way.

The hydroelectric pump is proving to be one of the most effective agents of coordination. It is being shown that under many conditions the raising of water to high lands with hydroelectric power is economically superior to the conveyance of water by gravity through long and tortuous main canals. In order to bring gravity-irrigation water upon many of the very fertile lands of the West, long and expensive main canals are necessary. Many of them, by reason of their location or by reason of the excessive stability or the instability of the material through which they must pass, are exceedingly expensive either in construction or maintenance. Many a western crop has been ruined and many a farmer has suffered loss or even bankruptcy because of the fact that in the midst of the irrigation season a break or other accident has occurred in the main canal which has deprived the fields of their irrigation water for a more or less extended period. We must take into consideration also the seepage losses in many of these large main canals. It has long been apparent that the amount of seepage water lost from such canals would, if placed on good agricultural land, produce large crop values.

The use of hydroelectric power for raising water from rivers, canals, and wells up to highlands which either lie above gravity irrigation or which are difficult and expensive to reach by gravity irrigation has entered into this most perplexing situation with valuable and beneficial results. It has already resulted and will in the future more often result in the abandonment of long

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high-line canals and the placing of water upon the lands formerly served by those canals, through pumps and pipe lines directly into the local distributing ditches. The abandonment of these high-line canals has thus made it possible to allow the water to descend to water-power sites, there to be used in the generation of energy. That energy in turn is used to raise an equivalent amount of water, either taken from the same or from other streams, up to lands formerly irrigated through the old main canals or to lands which theretofore have not been reclaimed. Of course this principle can not be extended to the absurd point at which it becomes analogous to the attempt of a man to lift himself by his boot straps. There are, however, many instances in which the amount of water, diverted by a high-line canal for irrigation service on a given area of land, would become far more of a resource in the community if it were allowed to descend to a power plant, there give up its energy, and then flow downstream to a point where a portion of it could be raised to some better piece of land. In the State of Utah, for example, water from some of the mountain streams of the Wasatch Range which could by expensive diversion be made to cover all the reclaimed land in that region, is allowed to descend to Utah Lake. The energy developed in transit is recovered in hydroelectric plants installed on those streams. A part of this energy is used to raise that same water from Utah Lake to the best lands of the region, and thus approximately 90,000 acres of land are irrigated more efficiently and far more cheaply than could be done by gravity irrigation. The writer is familiar with other situations in which long and expensive main diversion canals have been or are soon to be abandoned and in their place water is to be served by hydroelectric pumps.

There is another interesting point in connection with this pumping practice. In nearly every river basin of the West the agricultural value of the lands varies from place to place. The situations are rare in which an irrigation company, district, or association can absolutely pick and choose the lands which they desire to reclaim. In nearly every case there is more or less duress placed upon the developers to include, in their irrigation systems, certain relatively undesirable lands. Of course this is not a hard and fast rule, but we are compelled to admit that in the broad average case "the stage is set" by nature, and the irrigator is obliged to make his irrigation system to conform to natural conditions. The introduction of hydroelectric pumping imparts elasticity to the situation and grants a certain degree of option under which the water can, in large measure, be distributed according to the best interests of the whole community.

Hydroelectric power used for pumping during the irrigation season can, during the fall, winter, and spring seasons, be used for manufacturing and general public utility purposes. "Off-season" power need not always become secondary power, because coordination of many water-power plants in different drainage areas under a general system of electric transmission, and the diversity of use which there takes place, largely diminishes the amount of power that would otherwise be considered of secondary importance. The principle of coordination in water power and irrigation is therefore of broader scope than the mere correlation of water power and gravity irrigation demands. It extends to the diversification of power use and the consolidation of power systems so that local irrigation demands may be entirely served and the power demands of each region may not be neglected. All of this we may regard as an achievement of the near future.

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CONCLUSION.

Coordination in the use of our water resources requires a broad rather than a narrow concept; the issues are regional rather than sectional. Coordination is and may be prevented by unwise laws fixing hard and fast order of priority of use without regard to local conditions and circumstances; also by laws too liberal and by laws too severe. Coordination has been and in the future will, to a greater extent, be facilitated by progress in the hydrologic and electric sciences. With all these conditions well provided, coordination will finally be the result of mutual and intelligent behavior, and a spirit of common helpfulness among the men who, within any given area, possess interests which naturally conflict one with another.

The governmental machinery necessary to the coordination of water-power and navigation uses of water is already created and in operation. To operate perfectly that machinery requires merely that a few legal obstructions be removed from its gears. Coordination between water power and municipal supply and between water power and irrigation depend on local conditions, sometimes difficult and again easy, but each case requires treatment according to relative values.

## Adjournment.

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## SESSION OF SUBSECTION 2 OF SECTION III.[1]

FOREST SERVICE BUILDING,
DEPARTMENT OF AGRICULTURE,
*Wednesday morning, January 5, 1916.*

Chairman, H. S. GRAVES.

GENERAL TOPIC:

**Pan American Theme: "A National Forest Policy; the Relation of Forestry to the Future Development of Central and South America."**

The session was called to order at 9.30 o'clock by the chairman.

Papers presented:

The attitude of the Government in the matter of national forests; relation of forest culture to the future development of Central and South America, by Elías Leiva Quirós.

The conservation of the natural sources of wealth—agriculture, irrigation, and forest culture, by Raúl Brin.

The attitude of the Government in the matter of national forests, by Horacio Echegoyen.

El Tambu and the destruction of the "Tacuaras" of Paraguay, by A. Winkelried Bertoni.

Forest problems and economic development in South America, by Raphael Zon.

Scientific forestry for Latin America, by Barrington Moore.

### ACTITUD DEL GOBIERNO EN MATERIA DE BOSQUES NACIONALES—RELACIÓN DE LA SELVICULTURA CON EL DESARROLLO FUTURO DE CENTRO Y SUD AMÉRICA.

Por ELÍAS LEIVA QUIRÓS,

*Profesor de la Escuela de Derecho de Costa Rica.*

Una de las cuestiones que más han interesado la opinión en los últimos tiempos es la que se relaciona con la conservación y régimen racional a que deben estar sujetos los bosques y las aguas en estos países de América. Las aguas y los bosques son, se puede decir, dos aspectos distintos de uno solo y trascendental problema de administración pública, cuya solución reclama hoy día una intervención más directa de los gobiernos nacionales. El Segundo Congreso Científico Panamericano lo ha comprendido así cuando ha propuesto

[1] There was no stenographic report of this meeting.



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este asunto como tema de sus deliberaciones, creando una sección especial del mismo denominada: "Conservación de las fuentes naturales de riqueza: Agricultura, Irrigación y Selvicultura."

La existencia de grandes extensiones de selvas y arbolados constituye hoy día una riqueza de inapreciable valor en aquellos países en que la destrucción de ellos no se ha hecho todavía de una manera sistemática. El gran desarrollo que actualmente tienen en el mundo las industrias madereras y todas las que con ellas se relacionan, como la fabricación del papel, la extracción de gomas y resinas y las mismas industrias agrícolas, nos están indicando claramente cuál es el camino que deben seguir nuestros países si quieren conservar ese patrimonio forestal de que se manifiestan ya tan necesitadas muchas comarcas de la tierra.

Los bosques en el Centro y Sur de la América, especialmente en la parte tropical, están llamados a influir de manera muy notable en el porvenir económico de estos países. Las inagotables riquezas con que los dotó la naturaleza en maderas y frutas, en plantas de toda clase aplicables a todos los usos de la vida, hacen de esta parte del mundo un verdadero paraíso terrenal, no soñado todavía. Ya tenemos en ellos la fruta del pan;[1] en Costa Rica existe el árbol de la leche[2] y tenemos una palmera que produce el vino;[3] en la República de Chile se encuentra, formando bosques enteros, la palmera que da la miel; nada falta en su seno de lo que se considera más necesario y más útil para el alimento, vestido y habitación del hombre. Su composición es tan variada y heterogénea que los botánicos, a pesar de todo lo que han hecho, están todavía bien lejos de poseer el catálogo completo de todas las especies vegetales que contienen. Durante su permanencia en nuestro país, el Dr. Polakowsky pudo comprobar que existe un mayor número de ellas en un kilómetro cuadrado de nuestros bosques que en una extensión de 200 kilómetros cuadrados en el Canadá o en cualquiera de los países de Europa. La observación del geógrafo y naturalista alemán puede muy bien generalizarse en las demás regiones de la parte intertropical de la América sin que pierda nada de su valor como observación científica.

Aunque no estuviera suficientemente comprobada la influencia de las selvas en el régimen regular de las lluvias, estarían por demás justificados los ingentes gastos hechos por las municipalidades para fomentar su desarrollo en los suburbios de las grandes ciudades, ya que, suavizando el clima y mejorando la calidad del aire, impiden la propagación de ciertas epidemias y mejoran la salubridad pública. Un espíritu de imprevisión característico de la raza y que se refleja en los gobiernos de nuestros países, ha sido la causa principal del desaparecimiento progresivo del bosque y del arroyo; él será también la causa de la pérdida de ese capital que no nos pertenece, sino a las generaciones venideras, y cuyos intereses son lo único que tenemos derecho a usufructuar.

En Costa Rica, lo mismo que en el resto de Centro América, se usan, por desgracia, todavía los mismos métodos que pusieron en práctica los conquistadores españoles hace ya cerca de tres siglos en los desmontes practicados en estos territorios. Para despejar el terreno elegido como asiento de un cultivo se recurre al incendio de las selvas. El medio empleado no puede ser ni más irracional ni más improductivo. La utilidad que con ello reportan nuestros campesinos no se compensa con los enormes perjuicios que ellos mismos acarrean a la agricultura, fuente principal de nuestra riqueza. Especies enteras de árboles y plantas tendrán que ir desapareciendo poco a poco bajo las cenizas; éstas desaparecen también de los lugares del siniestro arrastradas por las lluvias torrenciales; las tierras, calcinadas y empobrecidas por esas combus-

[1] Artocarpus communis. [2] Galactodendron utile. [3] Acrocomia vinifera Oerst.

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tiones violentas, van perdiendo los principios fertilizantes que contienen y que por una acción sabia y continua de la naturaleza se habían venido acumulando allí en la forma de mantillos.

Pero eso no es todo; con la constitución química de nuestros suelos va cambiando además la constitución física de los mismos, y la disminución de la humedad, que es una de las más fatales consecuencias, los hace cada vez más inconsistentes y menos aptos para resistir a las fuerzas erosivas. Comarcas enteras de nuestro país, en otro tiempo apropiadas para la agricultura, están hoy cubiertas de helechos y zarzamoras, únicas plantas que pueden prosperar en tales condiciones. Los árboles aislados que quedan en esas antiguas socolas se desraigan fácilmente, dejando descubierto un subsuelo de naturaleza arcillosa y estéril; y, como suele pasar en las pendientes septentrionales de nuestra cordillera de Dota, las manchas rojizas esparcidas aquí y allá a lo largo de los caminos, van acusando la barbarie de los antiguos cultivadores.

Ha sido la altiplanicie central del país la que se ha sometido principalmente al proceso de la tala sistemática, porque también es aquí en donde se aglomera la masa más importante de la población; pero el día en que, mejorando las vías de comunicación, se decida a abandonar la meseta para colonizar y cultivar las grandes extensiones de tierras que aún permanecen inexploradas, la población actual llevará allá también, junto con el esfuerzo de su brazo, el consabido instrumento de destrucción.

En Costa Rica no son, por desgracia, muchas las personas que se dan cuenta cabal de los efectos de nuestra conducta imprevisora en materia de bosques nacionales. Como no existen estaciones meteorológicas suficientes que puedan dar gráficas del cambio que va experimentando el clima a consecuencia de la tala de los bosques, nuestros hombres representativos, en la mayor parte de las naciones centro y sudamericanas, no le han podido dar al problema forestal toda la importancia que reviste. Desde de año 1888 funciona en San José de Costa Rica un Instituto Meteorológico bastante completo, encargado de suministrar los datos sobre temperatura, presión atmosférica, sol, radiación solar y terrestre, humedad, cantidad de lluvias y estado general del tiempo, datos que generalmente publica la prensa del país y los anales del mismo instituto. Pero la utilidad que el Estado reporta de esas estadísticas es muy limitada comparada con el provecho que habría podido sacar si se hubieran proseguido las observaciones en las estaciones secundarias que en un principio se establecieron en otros muchos lugares del territorio. No hay que olvidar que el valor que adquieren esos números por la comparación, es lo único que puede dar una idea aproximada de las condiciones climatéricas de un país.

Pero si esos datos faltan en la mayor parte de las naciones latinas, no así los que suministra la experiencia de los agricultores en un período de tiempo relativamente corto. Hace 30 años no eran posibles entre nosotros los cultivos del café, plátano y caña de azúcar en zonas que pasaran de 1,500 metros de altura sobre el nivel del mar. Hoy día, debido a los desmontes, esos cultivos producen cosechas remuneradoras a muy cerca de 2,000 metros. Las piñas y las naranjas, limitadas antes a las vegas de los ríos y a los valles inferiores, comienzan hoy a escalonarse en las faldas de la cordillera volcánica central. Como el poder de aclimatación que tienen esas plantas no ha de ser tan grande para contrarrestar las condiciones de un clima desfavorable, hemos de presumir que ese proceso de aclimatación no es más que un efecto, y que el clima ha de haber sufrido un cambio apreciable en tres, por lo menos, de sus factores más importantes: la temperatura, la cantidad de lluvias y el estado higrométrico del aire.

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La formación de comunidades o de sociedades cooperativas forestales, en las cuales los capitalistas y agricultores interesados se unen para poner término a la devastación vandálica de las selvas y fomentar la replantación forestal, ha dado en la práctica escasos resultados cuando no es secundada por la acción oficial. Los propietarios tienen derecho a que el gobierno del Estado proteja sus intereses y los defienda cuando son amenazados, en los casos en que la iniciativa individual es ineficaz o insuficiente, y de aquí que, en lo que hace al problema forestal, el Estado tenga obligaciones ineludibles.

Veamos ahora en que forma la acción gubernamental o administrativa puede ayudar a resolver un problema de tan alta importancia para los intereses generales como éste de que nos venimos ocupando. La política del Gobierno sobre el particular tendrá desde luego que ser tan varia como varias sean las circunstancias o condiciones en que cada país se encuentre colocado ante el problema forestal.

En nuestros países tropicales de América, por ejemplo, en que el desarrollo natural de las selvas puede compensarse con las pérdidas ocasionadas por el uso que de ellas se haga racionalmente, bastaría con someterlos a una explotación moderada para que no se rompa el equilibrio que necesariamente tiene que existir entre las masas arbóreas y las extensiones dedicadas al cultivo, o, en otras palabras, para que su explotación se sujete a los límites de producción natural. En otros ya no sería suficiente esta necesidad gubernativa, sino que convendría obligar a los particulares dueños de bosques a plantar uno o más árboles por cada unidad de los que se corten en las selvas, o dar primas a los que dediquen sus terrenos a la formación de las mismas. Habrá algunos que se encuentren tan desprovistos de vegetación arbórea, por causa de explotaciones inmoderadas, que exijan la replantación de zonas enteras; y otros, en fin en que las disposiciones legales habrán de tener por objeto, no ya la repoblación de los bosques que tal vez no han existido, sino el mejoramiento de las condiciones físicas del suelo, la formación de capas vegetales para combatir las dunas de la orilla del mar, habilitando así comarcas estériles que no dan ningún provecho a la nación. La existencia de grandes extensiones de tierras pantanosas, eriales y yermos, constituyen siempre un obstáculo para el progreso material, cuando no un peligro para la salubridad pública. La expropiación de esas tierras por parte del Estado para dedicarlas a la selvicultura sería de gran utilidad pública, porque los particulares y antiguos dueños de ellas podrán reivindicarlas por un precio igual o mayor del que hubieren costado, incluyendo las mejoras. Estos, por su parte, conservarían intacto su derecho de verificar las plantaciones de árboles dentro del plazo que al efecto se les fije, estimulándolos el Gobierno con la concesión de primas o de premios y con la exención de contribuciones territoriales y otros impuestos sobre la producción.

A fin de darle a este asunto toda la importancia que tiene, sería muy conveniente que los países latinoamericanos interesados en la conservación y mejoramiento de sus bosques, que sería a no dudarlo, la totalidad de ellos, dictaran su respectivo Código Forestal, que sería ley en estas Repúblicas una vez que se les diera su aprobación con arreglo a los trámites a que están sujetas las demás leyes del Estado. A falta de una Dirección General de Bosques, habría necesidad de crear una Oficina o Sección especial como dependencia del Ministerio de Fomento, que atendiera de manera conveniente este servicio; que se hiciera, por medio de ese mismo departamento, una propaganda activa en el pueblo a fin de hacerle ver los provechosos efectos que, tanto en la climatología general como en el régimen de las lluvias, ocasiona la corta de los

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árboles; que se den las disposiciones conducentes a la formación de un personal idóneo en materia de bosques nacionales; que haga cumplir los reglamentos que al efecto han de dictarse por las autoridades administrativas; que éstos, en fin, contengan disposiciones para el severo castigo, así de los que rozan a fuego y queman o cortan en zona vedada, como de los que derriben los árboles en las orillas de las quebradas, ríos, esteros o canales de regadío. En esos reglamentos habrían de tomarse en cuenta, no sólo las consideraciones anteriormente apuntadas, sino también todas aquéllas que tiendan a asegurar el buen funcionamiento del servicio de aguas y bosques, ya que, como tantas veces se ha dicho, estos influyen directamente en la economía general del país y en el desarrollo de la riqueza pública y particular. Nunca sería demasiado insistir sobre este punto y sobre otro que nos permitimos señalar a los distinguidos miembros de este congreso: ha sido una especie de tradición en nuestros hábitos políticos el otorgar a nacionales y extranjeros franquicias incompatibles con los intereses nacionales y que no siempre guardan proporción con las ventajas obtenidas. En materia de bosques nacionales habrá que estar a menudo prevenido contra tales sorpresas y no conceder aprovechamientos forestales que excedan a las capacidades productivas de nuestros montes, ni explotaciones y cortas considerables sin obligación de repoblar por parte de los concesionarios. La más elemental prudencia aconseja, por otra parte, ir formando en nuestros países una reserva forestal análoga a la que tienen ya Francia, Suiza, Noruega y Alemania; reserva que explotada racionalmente podrá darnos, con usura, los intereses del capital que en ella hubiera de invertirse.

Guiado por los propósitos que inspiraron este trabajo, me atrevo a solicitar del congreso pleno, o de la sección respectiva, la aprobación de las siguientes conclusiones, que desde luego someto al estudio y consideración de los señores congresistas.

### CONCLUSIONES.

El Segundo Congreso Científico Panamericano declara:

1°. Siendo los gobiernos los representantes de los intereses generales, cuya guarda les ha sido confiada, están en el deber de dedicar al problema forestal la mayor atención posible, desde luego que este problema se encuentra íntimamente ligado al del incremento y conservación de la riqueza pública y privada.

2°. Es necesario que los gobiernos latinoamericanos que aún no lo han hecho, procedan a la formación del Código Forestal y a la división y delimitación de los bosques públicos con los de las comunas y particulares cuya conservación se considere necesaria, a fin de someterlos al régimen forestal que determinen las leyes.

3°. Es necesario que en todos los países representados en el congreso se disponga la formación del catálogo de montes y la del personal forestal idóneo, que son indispensables para la mejor aplicación y eficiencia de los reglamentos.

4°. Reconociendo que la Fiesta del Árbol es uno de los medios más eficaces para prevenir los perjuicios que ocasiona el exterminio de los bosques, tanto por su altísimo valor ético en la educación de la juventud como por la influencia que puede tener en las costumbres del pueblo, solicita la cooperación de los poderes públicos en el fomento y desarrollo de esta moralizadora institución.

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## ACTITUD DEL GOBIERNO EN MATERIA DE BOSQUES NACIONALES—LA RELACIÓN DE LA SELVICULTURA CON EL DESARROLLO FUTURO DE CENTRO Y SUD AMÉRICA.

Por RAÚL BRIN,

*Secretario de la Estación Experimental de Agricultura de Panamá.*

Es bien sabido de todos que los gobiernos fueron instituídos por los pueblos para establecer y mantener el orden entre los asociados y para dirigir y proteger los intereses de sus comarcas.

Las bases fundamentales de los intereses más caros de un país estriban en los elementos naturales de su territorio, acaso por razón de ser éstos limitados y de difícil, si no de imposible aumento, y estar, además, expuestos a disminuir y hasta desaparecer por falta de una juiciosa administración. Entre los elementos naturales de las naciones figuran los bosques o selvas, el más importante de los recursos que nos ha legado la naturaleza, aunque desgraciadamente, el menos apreciado por la mayoría de las gentes y gobiernos, quizás por el fatídico error de imaginarlos inagotables, y de aquí el que se haya abusado de ellos impunemente sin rendimientos apreciables para los menos, y sin provecho alguno para los más.

En todos los países del mundo el abuso de los bosques y el derroche de sus productos se ha practicado en escala alarmante, pero puede decirse, sin temor a incurrir en error, que en los de la América tropical es más asidua esa labor suicida que se ejerce inconscientemente con el asentimiento tácito de los dirigentes de los negocios públicos, quienes poco o nada han hecho para impedirlo o regularizarlo, y tal indiferencia es tanto más censurable cuanto que tenemos a la vista los estragos que esa imprevisión ha causado en muchos países del Viejo Continente, y las deplorables consecuencias que se harán sentir cada vez más.

Aquí, en nuestra América tropical, es irritante el sistema empleado por nuestros campesinos que pasan por agricultores. Cada uno de ellos debe, necesariamente, ocupar una nueva porción de bosque todos los años para allí hacer sus plantíos, cuyos rendimientos, dicho sea de paso, apenas si llegan a satisfacer sus más apremiantes necesidades. Escogido el sitio y sin preocuparse por la calidad de los árboles que allí vegetan, se entregan a la tala, y más tarde, cuando a fines de la estación seca todo el maderamen derribado ha sido tostado por la acción del sol, lo reducen a cenizas. Desde luego que, con muy raras excepciones, no se toman medidas tendentes a confinar el incendio provocado, de donde resulta siempre una no despreciable porción de bosque adyacente perjudicada por la propagación de las llamas. Bien es cierto que los perjuicios causados en los árboles desarrollados es relativamente pequeño, pero los sufridos por los arbolillos cuyo crecimiento se inicia es siempre considerable, porque no resisten a la destructora acción del fuego y perecen al igual de la hojarasca y otros despojos vegetales acumulados en el suelo, próximos a convertirse en fertilizante del terreno.

La titulada industria carbonera es otro flagelo de los árboles preciados de nuestros bosques. En la confección de este artículo, operación que aun se practica a la manera de los aborígenes de estos territorios, desperdiciando todos los productos que se desprenden de los maderos al contacto del calor, conformándose con recoger los residuos carbonizados, cuando, por puro abandono, no han dejado perder el todo, entran la caoba, el guayacán y otros más de utilidad para mejores fines; pero el más perseguido de todos es el mangle, árbol

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que crece en continuidad por millas de millas a orillas de los ríos, hasta donde ascienden las represas de las más altas marcas. Este valioso árbol por su semejanza, en desarrollo, al pino, aunque de mayor resistencia que aquél, está llamado a sustituirlo en lo que se relaciona con postes telegráficos, viguetas para construcciones y en cualquiera otra obra en que se requieran maderos derechos y de largas dimensiones. Este árbol utilísimo, es también víctima de los leñadores.

Además de los abusos apuntados que revisten el carácter de permanentes, existe otro tan devastador como aquéllos, con la atenuante de que está limitado a ciertos parajes. Me refiero a los explotadores del árbol de caoba. Esta explotación se verifica con la misma incuria que prevalece en todo lo que con los bosques se relaciona. Los árboles predestinados al sacrificio son siempre los más inmediatos a los arroyos y ríos, pues los que moran a regular distancia de estos son perdonados por lo penoso de su trasporte mediante los métodos primitivos de que se valen. Con el derribo del árbol, el cual se procura siempre que descienda sobre el mayor número de sus vecinos, que deja mutilados, se da principio al derroche. Del árbol caído sólo se aprovecha la parte del tronco de mayor espesor, desechando grandes porciones utilizables, y el tronco así elegido queda reducido casi a la mitad de su cubo en virtud de la forma cuadrada que se le da a pura hacha, astilla por astilla. Pero no queda aquí terminada la devastación. Queda todavía por trasportar la toza a la vía acuática que ha de arrastrarla hasta el embarcadero, y para ello se necesita abrir un camino o trocha de suficiente holgura que le permita pasar con todo un cortejo de labradores. Imaginaos, pues, la cantidad de arbolillos que perecen en esa operación; y si nos detenemos a pensar que por razón de encontrarse, generalmente, los caobos bastante diseminados, cada una o dos tozas que se aprovechan representan otras tantas trochas que se han abierto en los bosques, no podemos menos que horrorizarnos.

No menos imprevisión reina en la explotación de los árboles de goma elástica, de resinas y de cortezas. Muchos son los países de nuestro hemisferio que sufren sus consecuencias, aunque quizás ningún otro ha sido tan perjudicado como el nuestro en época en que Panamá y Colombia formaban una sola nacionalidad. Aludo a lo ocurrido en el país con la explotación del árbol de la quina y del caucho. Cuando el mundo comercial le encontró aplicación práctica y remunerativa a los productos de estos dos árboles, Colombia se encontró dueña de inmensas selvas pobladas de los preciosos especímenes. No bien fué el hecho conocido del público cuando los pueblos se arrojaron sobre esas selvas cual perros de presa. El hacha devastadora entró en acción, enloquecida, y a sus rudos golpes, es innegable, surgió una prosperidad que hizo época en la historia del país, pero eso sí, efímera, porque del gobierno para abajo nadie se preocupó en detener el brazo suicida y de establecer, en cambio, métodos racionales de explotación, y de allí que la ruina consiguiente al derroche de una cuantiosa riqueza que la naturaleza nos legaba y de la cual tenían pleno derecho de participar las generaciones sucesivas, no se hiciera esperar.

Unos pocos años bastaron para que el árbol de la quina, tan abundante al principio, fuera planta exótica en la república; y en cuanto al árbol del caucho, éste ha quedado reducido a su mínima expresión. Últimamente Colombia ha tomado algunas medidas encaminadas a reglamentar la explotación de ciertos productos vegetales, pero Panamá no ha dado paso alguno en el particular, si bien es cierto que en los pocos años que cuenta de vida independiente no sería justo esperar que pudiera abarcarlo todo. Dadas las circunstancias, harto ha hecho ya en la iniciación de la agricultura científica en el país con la fundación de una estación experimental adecuada a las necesidades, más el establecimiento de cátedras sobre la materia.

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Ya se verá, pues, cuantos centenares de miles de hectáreas de espesos bosques, y cuantos de preciosos árboles han sucumbido y siguen sucumbiendo al impulso inicuo de manos inconscientes respaldadas tácitamente por la incuria de los encargados de vigilar y proteger los recursos naturales de la nación.

Siendo así que las naciones que poseen cuantiosos recursos naturales están predestinadas a ser grandes y prósperas; que entre los recursos naturales resaltan por su importancia los bosques o selvas por la gran variedad de sus productos y las múltiples aplicaciones que tienen en las necesidades de los pueblos; que su fácil y exiguo costo de explotación los pone al alcance de todos, lo cual constituye un inminente peligro para su conservación, nada pues, puede tener tanta importancia como preservarlos, y en esta convicción y teniendo en cuenta que el hombre siempre abusa de la naturaleza y por eso se hace preciso la intervención de los gobiernos para contrarrestarlo, nos hemos visto impelidos a poner de manifiesto en este escrito los principales y más comunes abusos que se cometen con los bosques para patentizar más y más la inaplazable necesidad de protegerlos bajo el amparo de leyes adecuadas, de práctica aplicación, si es que aspiramos, como es natural, a ser algún día grandes y prósperos mediantes los recursos naturales que poseemos.

Pero una legislación al efecto no basta por si sola a asegurarnos el bienestar que perseguimos para nuestros pueblos. Se hace igualmente indispensable legislar sobre el establecimiento de "reservas de bosques nacionales" y escuelas de selvicultura y arboricultura a cargo de la nación. Este es asunto en que nadie puede disentir y es de la exclusiva competencia del Estado. Los siguientes conceptos emitidos por un autor idóneo en la materia, justifican nuestras conclusiones. He aquí como se manifiesta: "Otro aspecto de la intervención del Estado en la conservación de los bosques, y que está más íntimamente bajo su cuidado, es la creación y administración de los bosques. En todos los países donde haya montañas, existe la necesidad urgente de establecer "Reservas Federales de Bosques." Hay varias razones para ello:

"Las selvas de las montañas tienen otra importancia además de su producción de maderas. Están ubicadas a inmediaciones de las aguas de grandes manantiales, y de ese modo contribuyen a mantener la uniformidad de las corrientes, no sólo evitando inundaciones sino cooperando al incremento de las aguas utilizables como fuerza motriz.

"La selvicultura es el principal y más práctico de los asuntos públicos: puede decirse que es un trabajo nacional que sólo el Estado, cuya existencia es indefinida, puede llevar a cabo de un modo satisfactorio. La agricultura es negocio del campesino, es decir, de empresas privadas con intervención de peritos. Es un axioma en las escuelas forestales de Europa que el tiempo que se requiere para producir un árbol, es muy dilatado para nivelar la oferta y la demanda, sobre todo si se trata de árboles corpulentos.

"Es un deber del Estado proveer de madera al pueblo por medio de los empleados forestales. Es un deber del gobierno estimular y aconsejar a los agricultores en negocios y asuntos agrícolas; pero en selvicultura necesita hacer más. Es un deber del Estado producir toda la madera que el país necesita. Toda la cantidad de maderas que una nación necesita la deben producir sus propios bosques. Esta verdad podrá discutirse pero nunca negarse. Si se modifica, siquiera ligeramente, pronto tiene que sufrirse el castigo.

"La arboricultura es, sin duda, uno de los medios más eficaces y rápidos para asegurar la regeneración de una zona de bosques ya explotada, cambiar su carácter dándole valor."

Asegurada la conservación de nuestros bosques por los medios específicos sugeridos por la experiencia y por la ciencia, que nos hemos permitido recomendar, habremos asegurado, también, la conservación de otros recursos cuya nor-



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malidad está íntimamente asociada con aquéllos, y podremos entonces descansar en la confianza de que nuestro futuro desarrollo nacional es indiscutible e irresistible.

De los múltiples productos o materias primas que generosamente nos brindan los bosques, sólo la madera basta para hacer próspero a cualquier pueblo de la tierra, y a no dudarlo, éste será el eslabón que nos unirá a nuestra futura grandeza.

El eminente hombre público y ex-Presidente de la Gran República del Norte, Coronel Theodore Roosevelt, ha sido incansable en su patriótica labor de atraer la atención de sus conciudadanos, y a la vez del mundo entero, hacia la alta importancia de este artículo. En uno de sus elocuentes discursos ha dicho: "La madera es una parte indispensable de las estructuras materiales y en ella descansa la civilización. Debe siempre recordarse que aunque el inmenso uso del hierro y los sustitutos de la madera en muchas construcciones, han determinado una disminución relativa en la cantidad de madera en uso, este hecho ha venido acompañado de un aumento absoluto en el empleo general de ésta. Se utiliza actualmente mayor cantidad de madera que en cualquiera otra época de la historia." Y en otros, ha disertado con exquisita habilidad sobre la necesidad de conservar los bosques (por sus maderas principalmente) para hacer hogares felices; demostrando la estrecha relación que existe entre la selvicultura y la minería, y haciendo patente la imposibilidad de la explotación, con éxito, de preciosos yacimientos minerales existentes en los Estados Unidos de América, debido únicamente al alto precio de la madera con motivo de su creciente escasez.

Esta escasez de la madera en aquel país ha sido, más tarde, corroborado por el Jefe de los Bosques de la Nación, quien ha dicho por la prensa que no sólo hay empobrecimiento manifiesto de madera, sino que éste marcha a pasos agigantados.

En el asunto de la escasez de maderas en el mundo el Sr. M. Melard en su obra intitulada "La insuficiencia de las existencias de madera en el mundo," se expresa así: "Son hoy pocos los países en la Zona Templada del Norte capaces de proporcionar madera en grandes cantidades. Cinco en Europa, a saber: Austria-Hungría, Suecia, Noruega, Finlandia y Rusia; dos en la América del Norte que son: Canadá y los Estados Unidos. Se ha demostrado que el sobrante de maderas disponibles de Austría-Hungría, de Rusia y de los Estados Unidos está seriamente amenazado por el aumento de la población y por el desarrollo industrial; y el de Noruega por el abuso del hacha. Quedan solamente tres lugares en que se puede confiar por algún tiempo: Suecia, Finlandia y Canadá; pero son absolutamente insuficientes para cubrir la demanda mundial. Si Suecia, Finlandia y Canadá intentaran abastecer de madera a todos los países que están a su alcance, tanto su producción normal, como sus bosques, se consumirían en muy poco tiempo, así como sus ingresos y su capital." Concluye el referido autor, con la observación de que: "salta a la vista la gran escasez de la madera."

Los juicios que dejamos transcritos, provenientes de personalidades de indiscutible competencia, y de muchos otros más que omitimos bastan por sí sólos para hacernos justicia en nuestras apreciaciones respecto al desarrollo que le está reservado a nuestros países de la América Latina con la sola explotación (se entiende científica y metódica) de las maderas de sus bosques, pero hay todavía un hecho más, que no debemos dejar de mencionar, que contribuirá a acercarnos al desideratum; la destrucción de los bosques en los teatros de la guerra actual en Europa, y terminado el conflicto, la incalculable demanda de madera, de todas clases, para reponer la propiedad urbana y marítima destruída.

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Resumiendo las consideraciones que dejamos expuestas en el curso de este estudio, inspiradas por la observación, los dictados de la experiencia y los fueros de las naciones latinoamericanas, llegamos a la conclusión que los gobiernos de los Estados como dirigentes que son de los destinos de sus comarcas, están en el deber ineludible de proteger y conservar los bosques nacionales, fuente de riqueza pública, mediante la expedición de leyes adecuadas de práctica aplicación y de inexorable cumplimiento, y del establecimiento de reservas de bosques nacionales y de escuelas de selvicultura y arboricultura; y que en la selvicultura, bien entendida y mejor practicada, estriba el futuro desarrollo y consiguiente prosperidad de los pueblos de Centro y Sud América.

## ACTITUD DEL GOBIERNO EN MATERIA DE BOSQUES NACIONALES—RELACIÓN DE LA SELVICULTURA CON EL DESARROLLO FUTURO DE SUD AMÉRICA.

Por HORACIO ECHEGOYEN,

*Miembro del Directorio de la Sociedad de Historia y Geografía de Chile.*

El territorio chileno fué excepcionalmente favorecido por la naturaleza con montañas de valiosas y variadas especies forestales.

La longitud considerable de su territorio permitió el desarrollo de árboles pertenecientes a los climas subtropicales, templados, semitemplados y fríos; la ordenación de sus dos cordilleras, Andina y de la Costa y la de los numerosos cordones que las unen ha hecho posible la multiplicación de árboles de diversas zonas, fuera de su centro aborigen, porque la altura modifica el calor y hace más permanente o estable el régimen de los vientos.

Cuando Pedro de Valdivia ocupó a Chile, 1540–41, la extensión del bosque chileno era casi igual a la de su territorio; porque, si bien es cierto que casi todo el valle central estaba cubierto por arbustos—romeros, en las aguadas, molles, alcaparra, coliguay, olivillo, etc., en el norte y con espinos y algarrobos, en el centro hasta el Ñuble—es una verdad conocida que el terreno despejado arable era escasísimo, pues las Cordilleras altas y sus ramales estaban cubiertas de espeso bosque.

En 1744, año en que se fundó San Francisco de la Selva—hoy Copiapó—el bosque se extendía por el flanco de las dos Cordilleras y gran parte del Valle Central, desde los linderos del Desierto de Atacama hasta el estrecho de Magallanes, o sea en la extensión de 26 grados geográficos, desde el 27 al 53 de latitud sur.

No corresponde aquí enumerar las distintas clases de árboles forestales que poblaron el territorio de Chile, pero puede afirmarse con el testimonio de muchos hombres de estudio, desde Humboldt y D'Orbigny, que ningún país del mundo le superó en variedad y calidad de maderas destinadas a las construcciones de toda especie y a la ebanistería y usos industriales. Si hasta fechas recientes se viene estudiando el verdadero valor de las especies por algunos espíritus ilustrados, la gran masa de la población no atribuye al arbolado otro valor que el de un pasajero lucro, despreciando y quemando lo que no produce dinero en el momento de ser transformado en piezas de barraca. Una estadística imperfecta, bastante reciente, manifiesta que en todo nuestro territorio quedan 4,106,685 hectáreas de bosques, incluyendo en esta cantidad el suelo cubierto con arbustos y renuevos.

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Siendo la extensión de Chile de 75,244,200 hectáres, el arbolado repesenta un 5.45 por ciento, lo que según las estadísticas puede servir las necesidades de la población actual.

Esto indica que si no se repone lo perdido, luego habrá que importar del extranjero madera de construcción.

La estadística que hemos citado indica que han desaparecido por el roce a fuego y la imperfecta explotación, once millones de hectáreas de bosques para dedicar el suelo a la agricultura o a una esterilidad interminente, que, en parte, va haciéndose permanente por escasez de lluvias 1820–1910.

El cálculo anterior da a entender que sólo la séptima parte del territorio estuvo cubierta de árboles en tiempo de la Conquista. Nosotros creemos que este porcentaje es bajo y que se podía haber elevado al 20 por ciento.

Este 20 por ciento de la vieja área forestal que representa 150,488 kilómetros cuadrados, de la cual sólo quedan 41,011, puede repoblarse mediante un trabajo inteligente que distribuya el arbolado según las necesidades y climas de cada región.

* * *

Cuando en 1818 Chile proclamó su independencia tuvo que seguir rigiéndose, durante no pocos años, por la legislación española, modificada a cada paso según las necesidades urgentes del momento.

La Novísima Recopilación[1] estableció con amplia liberalidad la servidumbre de la leña y el aprovechamiento del bosque por los habitantes de las ciudades. Las Ordenanzas de Minería dieron, poco más tarde, libertad al minero de usar los montes vecinos para la explotación y beneficio de las minas sin pagar nada en los montes concejiles, comunes o alcaldíos. Cuando el bosque perteneciera a particulares debía pagarse la indemnización que fijara el juez de minas del partido.

La misma ordenanza autorizaba el denuncio de los bosques no amparados por un título legal en beneficio de la minería.

Este denuncio fué derogado después de producir inmensos males por la ley de 15 de julio de 1872, primera ley nacional que ampara la Foresta Chilena.

El Código de Minería vigente en su artículo 6° establece la servidumbre de la leña, previa indemnización, en los fundos de particulares a favor de toda mina que se denuncie, sin otra limitación que la de que cesa la libertad de tomarla cuando el propietario del fundo la entrega cortada.

Esta disposición encierra tácitamente la libre y amplia servidumbre del bosque en los terrenos del dominio nacional.

Hasta 1872, tanto la Sociedad Nacional de Agricultura como el Senado y la Cámara de Diputados intentaron derogar la denuncia del bosque y la servidumbre gratuita de leñas y toda especie de maderas en terrenos fiscales con alguna protección al arbolado en tímidos ensayos de leyes y aun de un Código Rural; pero los intereses mismos, siempre respetables y poderosos en el país, y en especial, la ignorancia absoluta de nuestros legisladores en materia forestal, ahogaron estos ensayos de buena voluntad.

El Código Civil chileno, siguiendo análogas disposiciones de otros países, confiere al usufructuario de un bien raíz el derecho de aprovechar el arbolado en las necesidades exclusivas del bien a su cargo y con obligación de replantar todo árbol que derribe; igual goce da al colono o arrendatario de una propiedad siempre que cumpla la obligación de reponer todo árbol derribado, repitiendo que este goce se refiere a la satisfacción de las necesidades del predio y no al deseo de ganar terreno para cultivos.

[1] Como su nombre lo indica, es un cuerpo de leyes en que se han recopilado las leyes españolas que más directamente se relacionaban con las colonias de América.

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Tres años después de la promulgación del Código Civil, por decreto de 7 de julio de 1859 se prohibió en los bosques fiscales de Llanquihue y Chiloé la corta de alerces que no tuvieran las condiciones requeridas para su explotación.

Por fin en 13 de julio de 1872 se promulgó la única ley que se ha elaborado en Chile para defender, en parte, la destrucción del patrimonio forestal de la nación por la ignorancia supina de las gentes más que por inspiraciones de ingénita maldad o inconcebible torpeza.

Esa ley derogó el denuncio de bosques, limitó a tres años el goce de los ya concedidos ,siempre que estuviera en trabajo el establecimiento minero a que debía servir y para satisfacer únicamente sus necesidades, durante ese período y anuló los denuncios destinados a faenas mineras aun no establecidas en la fecha de la ley; prohibió el corte de árboles y arbustos en las cercanías de las vertientes y en los nacimientos de los manantiales y facultó al Presidente de la República para determinar las reglas "a que debe someterse la explotación de los bosques en cada departamento, pudiendo prohibir el corte de los árboles en los cerros hasta una altura que evite la destrucción del terreno vegetal."

En 3 de mayo de 1873 el Presidente de la República, haciendo uso de esta facultad reglamentó la explotación de bosques.

El reglamento prohibió el corte de árboles cercanos, 400 y 200 metros de los manantiales y nacimiento de aguas, los situados en cerros desde la medianía de sus faldas hasta la cima, señalando como cima en la Cordillera de los Andes la línea de las nieves perpetuas; prohibió absolutamente la roza a fuego en el territorio de la República hasta el Bio-Bio (grado 36.40 lat. sur) y más al Sur, sólo con permiso de la autoridad y con severas restricciones; y autorizó la explotación de bosques del Estado por medio de arrendamientos "conforme a las leyes." Las condiciones de cada contrato debía formularlas el Intendente de las provincias y solicitar la aprobación suprema.

El resto del reglamento crea un Inspector General de Bosques y otros dependientes de éste, autoriza el denuncio de las infracciones y establece penas severas y reglas de procedimiento breves y sabias. Impone además a los Jueces Letrados la obligación de levantar un sumario indagatorio de oficio cada vez que se denuncie o presencie un incendio de bosques.

Dos años después, al usar el Ejecutivo las facultades que le concedieron las leyes de radicación de indígenas y colonización por extranjeros, de diciembre de 1866 y 4 de agosto de 1874, dictó un decreto fechado el 16 de enero de 1879 que dispuso que en las ventas de terrenos del Estado de los departamentos de Angol y provincias de Arauco, Valdivia, y Llanquihue (centro sur del país) se reserve una faja de montaña que no baje de 10 kilómetros, contados desde la Cordillera de los Andes hasta la de la Costa, tomada a lo largo de norte a sur en otros cerros cubiertos de bosques y en la Cordillera de la Costa de esas provincias, se reservará una faja de un kilómetro. Esta reserva debía ser del exclusivo dominio del Estado.

Con excepción de la ley de presupuestos de 1912, que creó la inspección de bosques, pesca, y caza de que nos ocuparemos más adelante, lo extractado es cuanto existe en materia forestal en la legislación de Chile.

Es necesario declarar, aunque duela a nuestro patriotismo, que ninguna de estas disposiciones ha sido respetada hasta el día.

La Zona del Norte estuvo desde la Conquista hasta la llegada al país de la navegación a vapor con itinerarios fijos, muy alejada del poder central por las grandes distancias que era necesario recorrer por malos caminos y en territorios extensos, despoblados y desprovistos de todo recurso.

Por igual razón los establecimientos mineros estuvieron a su vez muy desprendidos de la acción de las autoridades lugareñas, porque si bien es cierto que hubo veedores e inspectores de minas, durante la colonia, que cumplían

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celosamente el deber de examinar la técnica del trabajo en el interior de las minas, a ninguno de ellos se le ocurrió jamás que el uso inmoderado del bosque, era un peligro nacional.

Para colmo de males, desde 1821 ó 1822 se comenzó a popularizar el uso de los hornos de reverbero, introducidos al país por el distinguido francés don Carlos Lambert, que hizo fácil el beneficio de los bronces en las minas de cobre. Siendo el territorio de las provincias de Aconcagua, Coquimbo y Atacama una no interrumpida sucesión de minerales de cobre de alta ley, las fundiciones se multiplicaron rápidamente y como al mismo tiempo se beneficiaban muchos ricos minerales de plata y oro, no es de extrañar que en los primeros setenta años del pasado siglo se agotara total y absolutamente el tupido, noble y rico bosque de las tres provincias nombradas.

La ley de 1872 sirvió sólo a los bosques del valle central, de Santiago al Sur, donde la minería no fué nunca tan rica, ni tan variada, ni tan abundante. Pero aquí destrozó el bosque el incendio y el modo anti-industrial y anti-comercial de beneficiar los árboles de construcción. Así el bosque que pudo servir las necesidades de dos siglos en todo el valle central, desde el Aconcagua al Bio-Bio, se extinguió, hasta en los primeros contrafuertes de la Cordillera, pocos años después que el riel uniera a Santiago con la Metrópoli del Sur, Concepción, en 1875.

La distribución del territorio que hicieron los gobernadores españoles desde 1541 a 1810, sin ningún criterio gubernativo, sin previsión ni consideración al porvenir, sin cortapisas ni restricciones, contribuyó poderosamente al desperdicio precipitado del valioso, riquísimo bosque, de las provincias del Norte ya nombradas (grado 27 al 32.30) porque el propietario no podía vigilar tan extensos dominios. Razones parecidas precipitaron la roza y explotación del arbolado en las provincias centrales hasta el Bio-Bio, o sea el grado 37°.

En las provincias araucanas de Malleco, Cautín, Arauco y Valdivia, en que el Estado recibió la montaña virgen más hermosa y de más valor que hubo en Chile, han bastado los 50 años corridos desde la primera penetración pacífica del territorio araucano y su próxima definitiva conquista—1865 a 1882—para que la población de batalla que precede a la organización de los terrenos conquistados, la escasez de autoridades, el ansia del lucro y la condición de comunidad con los indios en que vinieron esos territorios al dominio del Estado, arrasaran los dos tercios del bosque.

Estudiando más á fondo esta cuestión, se llega a la conclusión de que la explotación arbitraria, casi bárbara, de nuestras riquezas forestales, se debe principalmente a la ignorancia absoluta en que han vivido las generaciones anteriores, de las funciones que desempeñan los árboles en la naturaleza, de la ignorancia de la más elemental economía y de la falta, también absoluta, de una estadística forestal, que indicara el consumo nacional anual en relación con la explotación y roce también anual, y de la existencia total del bosque en el territorio de la República.

El agotamiento del alerce en Llanquihue y Chiloé y del alerce y el ciprés en las islas y territorio firme de los grados 41 a 43, se debe al aislamiento en que permanecieron hasta el establecimiento de los vapores con itinerario fijo, a la facilidad de explotar los bosques mostrencos o de propiedad del Estado, que era lo mismo, y a la baratura de los fletes, pues Chiloé fué siempre pueblo de marinos intrépidos que navegan en las embarcaciones más desmanteladas y desvencijadas que se conocen con igual confianza que en un gran transatlántico.

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La revelación hecha en el ensayo de estadística citado más arriba ha alarmado al gobierno y al país y es de esperar, que conociendo el peligro que corre-

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Por felicidad algunos espíritus previsores, aprovechando las disposiciones de la ley de creación de ministerios (1887) crearon en el Ministerio de Industria la Sección Aguas y Bosques, que andando al tiempo, se convirtió en la actual Inspección de Bosques, Pesca y Caza.

Sin la autoridad que da la ley a los organismos de la Administración nacional, sin ninguna autonomía y con muy escasos recursos, esa repartición ha hecho una obra educativa y técnica valiosísima e inmensamente superior a la que podía esperarse de la modestia de su nacimiento y la siguiente falta de ambiente y apoyo gubernativo, por no existir aun en el Ministerio de Industria política agronómica definida ni una sección especial que vele exclusivamente por la agricultura general.

Esta obra extensa y valiosa se debe a la competencia, actividad y capacidad superior de trabajo de su primer jefe don Federico Albert y de sus distinguidos colaboradores, los actuales inspector de bosques, pesca y caza don Ernesto Maldonado y jefes de secciones señores Cubillos, Castillo, etc.

Uno de los primeros resultados de la labor de esa oficina fué la de reconocer las especies aborígenes que forman nuestros bosques, el reconocimiento de la extensión de éstos, el estudio del valor técnico, industrial y comercial de las maderas, el modo de reproducirlas, etc.

Después ha venido la prueba práctica del servicio que presta el arbolado en la extinción de las dunas y del valor comercial enorme que significa el cumplimiento del deber del Estado, de las municipalidades y de los particulares de impedir que las arenas ahoguen poblaciones o campos de cultivo.

Ha conseguido iniciar el cumplimiento de la ley de 15 de julio de 1872 que manda reservar la montaña en las altas cumbres, obteniendo la cesión de 33,640 hectáreas de bosque fiscal en Malleco, y la reserva de considerables extensiones en los cordones de la cordillera Andina desde el Malleco al sur.

Ha podido instalar varios viveros para vulgarizar la plantación de árboles y enseñar el modo de conservarlos e iniciar la plantación de un bosque en los linderos del noreste de la ciudad de Santiago y en la hoya de las corrientes de agua que la proveen de este elemento indispensable a la vida. Pero más que todas sus obras, aun las de más práctico e inmediato valor para la economía nacional, la que será de más importancia en el porvenir es la labor social de vulgarización de conocimientos forestales del valor de las maderas y del interés que existe, en bien de los propietarios y de sus familias, por hacer plantaciones en grande o pequeña escala.

La Inspección de Bosques, Pesca y Caza ha formulado un bien meditado proyecto de ley de repoblación forestal que será muy pronto ley de la República. Se basa especialmente en la evolución del concepto absoluto de propiedad reconocido ahora por las naciones más civilizadas de que la propiedad es sagrada e inviolable sólo cuando cumple con los fines sociales para que fué instituída por el concurso unánime de las generaciones que forman los pueblos civilizados.

Habiéndose reconocido que el arbolado es necesario a la salubridad pública como el sol y el viento y que, como la tierra de labor, satisface necesidades inmediatas e ineludibles de la comunidad, se comienza a facultar al Estado para que haga regla la excepción del principio constitucional que ampara la propiedad como el derecho de la vida: "la necesidad pública."

Ordena pues ese proyecto que en los terrenos declarados forestales por la autoridad, no se abata un árbol sin la obligación de replantarlo en el año inmediato siguiente y que, en aquéllos en que ha desaparecido el arbolado, se plante anualmente por el Estado una cantidad de árboles que debe ir aumentando de año en año.

Estimula además la acción de los municipios y de los particulares a la plantación de bosques por medio de obligaciones severas, sancionadas con multas,

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y con la concesión de primas y exención de contribuciones por el período en que el terreno ocupado por los nuevos bosques no produzca ningún beneficio inmediato.

Sólo de esta manera y procediendo con gran energía podremos defender el porvenir.

Se ha calculado que las 4,100,000 hectáreas de bosque total permitirá a la población actual de Chile explotar anualmente 19,000 hectáreas para satisfacer sus necesidades, o sea que una población de 3,500,000 habitantes necesita para alimentar su actividad industrial, social, agrícola, etc., beneficiar 19,000 hectáreas de bosques.

Pero como es sabido que nuestro sistema de explotación sólo aprovecha la mitad de la montaña, es muy de temer que estas 19,000 hectáreas no satisfagan las necesidades del país y que el gasto anual sea mucho mayor.

Precisa además recordar el crecimiento de la población que, si es lento hoy (uno por ciento al año), será activo en diez años más, cuando se generalice el beneficio del agua potable abundante, el alcantarillado, los buenos pavimentos y la plantación de parques o bosques en los suburbios de las poblaciones y el progreso de la instrucción y de la educación pública inculquen en todos los habitantes hábitos de aseo e higiene.

Aparte de estas consideraciones, la enseñanza comercial abrirá a la actividad individual nuevos rumbos que, ayudados por la formación de capitales que proporcionan el ahorro y el ensanchamiento de las fuerzas de producción del país, demostrarán que el negocio agrícola de más consideración, tanto hoy como mañana, es la plantación de bosques en todos los terrenos inadecuados para la agricultura o para el forraje del ganado.

Se sabe que en el siglo pasado se han arrasado once millones de hectáreas de buenos y hermosos bosques; reponiendo esta superficie en las regiones y terrenos que, repetimos, no sean aptos para la producción agrícola, habríamos asegurado la satisfacción de las necesidades de una población dos veces y media superior a la actual o sea de doce millones de habitantes.

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No deben, sin embargo, detenerse aquí las expectativas forestales del país. Es sabido que el bosque es una fuente inagotable de riqueza.

También es de todos sabido que el aumento incesante de la población de las naciones europeas que, grande o pequeño, es constante (salvo Francia en que pasajeramente parece detenido) las obliga a consumir mayor cantidad de madera que la que producen.

Esta necesidad creciente las obligará a dedicar a cultivos parte de los terrenos que hoy dedican al bosque; el aumento normal de la población irá aumentando el consumo, y, como la producción disminuirá, las importaciones irán en constante aumento.

El fenómeno amenazará a los mismos Estados Unidos de América en un porvenir no lejano por el enorme aumento de su población y de su industria.

Esas naciones tienen que ocurrir para proveerse de maderas, a las naciones de escasa población con sobrados terrenos inadaptables a la agricultura, pero ricos para la plantación de bosques.

Entre los países de América que más pueden contribuir a salvar las necesidades de Europa y Norte América, Chile ocupa un lugar privilegiado, no sólo por la variedad y riqueza de las especies aborígenes, la feracidad de su tierra y su clima incomparable, sino por la configuración de su territorio que permitirá llevar a los puertos de embarque toda su madera con fletes reducidos y muy cortos recorridos fluviales o ferroviarios.

El progreso de la industria y de la actividad comercial van exigiendo mayores consumos de madera en cada año y la sola producción de celulosa y la de

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duelas y cajones para la próxima futura exportación de nuestros productos a Europa y Estados Unidos, y es un nuevo factor de gran consumo.

La producción de celulosa en nuestro país será pronto un hecho y, como tenemos especies adecuadas a esta fabricación como pocas de las especies europeas, no será de extrañar que se instalen pronto otras fábricas. Nuestro actual beneficio de los bosques, y cualquiera que sea el del porvenir, deja y dejará de aprovechar la mitad o el 40 por ciento del arbolado, que debe ser aprovechado por la celulosa.

Las maderas aborígenes utilizables por la ebanistería serán pronto solicitadas en grandes cantidades.

La necesidad de corregir el régimen torrentoso de nuestros ríos y la de atraer las humedades de la atmósfera hacia el suelo, especialmente en las Provincias del Norte, así como la lucha contra las dunas, tendrán que reponer muy pronto el consumo de superficies de bosques superiores a lo que permite la actual población forestal del país.

Felizmente para Chile su territorio le ofrece una superficie inadecuada a la agricultura superior a la que hoy se destina a cultivos y pastoreo. Se calcula que la agricultura puede usar 185,000 kilómetros cuadrados, quedando, por ahora, sin destino o cubiertos de bosques 567,000 kilómetros cuadrados. Puede, pues el país, destinar a plantación de bosques más que la superficie destinada a la agricultura, seguramente 200,000 kilómetros cuadrados, volviendo hacia lo que fué este país en 1541, corregido por la técnica del ingeniero forestal.

La producción del bosque es tan grande que todo cálculo que hiciéramos quedaría corto.

En Alemania, donde el crecimiento de los árboles es muy lento por exceso de fríos y escasez de días de calor, se comprobó hace poco que un pequeño bosque recién formado, comprado en 1892 por un padre de familia, produjo a sus hijos, a los 20 años, en 1911, siete veces el precio de compra y el valor de los árboles que hubo que sacar periódicamente para ralearlo, a fin de que se desarrollaran mejor los más fuertes, los que importaron sumas que habrían elevado a diez u once veces ese precio.

Pero no siendo pertinente dilucidar aquí este punto nos bastaría por ahora decir que cuando nuestras maderas sean conocidas en Europa y haya fletes económicos, su precio actual doblará y el aprovechamiento del árbol será integral, lo que dará a los propietarios y al país doble beneficio. Queda sí de manifiesto que debiendo ser la América del Sur en un porvenir próximo, la proveedora de buena parte de las necesidades de Europa y de Norte América, hay conveniencia general de estudiar los regímenes forestales que convengan a cada país y el modo de llegar a la repoblación del arbolado en el más breve tiempo que sea posible.

Y no siendo antagónicos los intereses forestales de las repúblicas de América se debe formular un voto sincero y cordial porque todas, o un grupo de las principales de ellas, sino fuera posible reunirlas a todas, se junten en congresos destinados exclusivamente al estudio de los medios de estimular y reglamentar la repoblación forestal y de la fundación de escuelas que formen el personal de ingenieros forestales, inspectores de bosques y demás funcionarios de la Dirección de Bosques de todas las repúblicas americanas.

Con estos antecedentes, parece que se imponen, como conclusiones, las siguientes:

1. Que debe ordenarse el inmediato reconocimiento de los terrenos de todo el país que deben dedicarse a la plantación de bosques por no ser aptos a la agricultura ni al pastoreo en los predios de todo dominio;

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2. Que debe estimularse el estudio, clasificación y replantación de las especies forestales nacionales en las zonas de su origen, con preferencia a toda otra madera en los dominios del Estado;

3. Que debe, sin pérdida de momento, nombrarse una comisión de agrónomos, abogados y funcionarios de la inspección de bosques para que formulen un proyecto de código de aguas y bosques;

4. Que debe solicitarse del Estado la creación de una escuela forestal y la agregación a los programas de instrucción de los conocimientos de geografía y economía forestal más indispensables al conocimiento de esta grandiosa fuente de riqueza nacional; y

5. Que se hace necesario buscar el concurso de las naciones vecinas para iniciar desde luego la misión que deberá desempeñar la América del Sur en la satisfacción de las necesidades forestales de la Europa en la construcción, en la industria, en el comercio y en la ebanistería y bellas artes.

## EL TAMBÚ Y LA MUERTE DE LAS TACUARAS EN SUD-AMÉRICA.

Por A. DE WINKELRIED BERTONI,

*Asunción, Paraguay.*

En más de una ocasión capitalistas extranjeros enviaron técnicos al Alto Paraná para estudiar la explotación de los tacuarales para la fabricación de celulosa, aprovechando los saltos como fuerza motriz. Además, las tacuaras, como es bien sabido, son de mucha aplicación en la vida del campo, en toda le región del Alto Paraná, entre Corrientes y el Guairá. En tal estado de cosas, durante la estación de 1913–14, todos los tacuarales que poblaban las riberas del Río Paraná florecen, fructifican y mueren. Una vez más coincide la fructificación de las bambusáceas con una gran invasión del Tambú comestible, o sea la larva de la mariposa nocturna, *Mielobia smerintha* (Hübm.), hecho que parece ocultar revelaciones curiosas para la ciencia. Con motivo de las consultas hechas por el "Museu Paulista," me propongo ocuparme brevemente de este asunto que vengo estudiando desde hace años.

Cabeza de Vaca, Saint Hilaire y otros de la antigüedad tratan brevemente del Tambú comestible en cuestión; pero los primeros datos biológicos y su relación con las tacuaras, en que vive la larva, son los observados por B. Furtado y ampliados por Miranda Ribeiro, en A Lavoura, de Río Janeiro. Habiendo yo, llegado al mismo resultado que estos últimos autores en lo que se refiere a la evolución de la larva, omito por hoy los detalles. En tres especies de tacuara, dyatevó, takuarusú (*Bambusa guadua*) y takuapí (*Merostachys fistulosa*), observé que el parásito es la larva de una sola especie de mariposas, cuya determinación ha sido comprobada últimamente por Hampson, el más grande especialista sobre ejemplares de Puerto Bertoni. No hay, pues, razón para creer con el Sr. M. Ribeiro que pueda haber más de una especie para las diversas tacuaras. Mi colega y amigo, R. von Ihering, en un reciente estudio publicado en "O Estado de Sao Paulo" trata también de la misma especie como parásita de un Merotachys (takuapi), y sus observaciones biológicas concuerdan con las mías.

No sólo en la antigüedad, sino hoy mismo, la larva de la *Mielobia smerintha*, o tambú de las tacuaras, es muy buscada como alimento y como medicamento, y por su aspecto y escasez de vísceras, no tiene nada de repugnante. Pero es

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rara y las invasiones coinciden con la fructificación de las bambusáseas. Los problemas oscuros son: La influencia que pueda tener el parásito sobre la inflorescencia, la fructificación y la muerte total de la planta (si tal influencia existe); el porqué las invasiones se suceden con tantos años de intervalo, y, por fin, porqué en años normales las plantas de tacuara maduran sin fructificar, a pesar de ser comunmente parasitadas por larvas de coleópteros. Según Burmeister, esta mariposa es capaz de largos vuelos, y, como las tacuaras fructifican en años diversos, según la especie y región, lo lógico es pensar que sea el insecto el que viaja en busca de tacuarales en flor y que en este estado la composición de la planta sea más favorable para la nutrición de las larvas. En años normales hallé raras larvas en Dyatevó sin flor, pero muy poco después de la primera invasión que he observado. En cuanto al imago, sólo lo cacé en tiempo de invasión general. Es de creer que cuando no hay tacuaras en flor en una región la mariposa viaje en su busca, si no existe algun parásito o epidemia que se encarga de reducir rápidamente el número de ejemplares, re tiempo en tiempo, o sea el ciclo que ya he señalado en otros insectos. Entre los enemigos naturales del tambú señalo a las aves de la familia Picidæ (ihpekú), y el mono común (*Cebus fatuellus*), que hemos observado dedicado a la extracción, agujereando las tacuaras con sus poderosos dientes. La invasión de ratas no ha coincidido, en P. Bertoni, con la floración de las tacuaras.

Se dice que nuestra tacuara común (*Bambusa guadua*) florece cada 30 años. En esta ocasión, si mal no recuerdo, aconteció con 27 ó 28 años de intervalo. Todas las plantas y casi todos los canutos estaban parasitados, y las larvas terminaron su evolución con la muerte de la planta. Como la tacuara grande se cría en las orillas de los ríos, donde el suelo es generalmente limpio, su abundante semilla germina fácilmente y se repone en un razonable número de años para la explotación.

No pasa lo mismo con el ultilísimo takuapí (*Merostachys fistulosa*), que se cría en un medio muy distinto y lucha con grandes dificultades para reponerse. La única floración general de que tengo noticias, acaeció en la estación de 1909–10, un par de años antes que la tacuara grande y el takuarembó. La fructificación ha coincidido también con una gran invasión de tambú en todo como el Sr. Furtado describe de la takuara kihsé del Brasil. Lo propio que en la tacuara, las larvas practicaron un agujero elíptico antes de transformarse en crisálida, para dar salida luego a la mariposa perfecta. Lo mismo han hecho con la pared de madera algunas larvas que aprisioné para criar, gracias a sus poderosas mandíbulas, si tal nombre puede darse a su boca. Las mariposas son bastante variables en magnitud, diseño y densidad de su color amarillento fundamental, pero pertenecen a la misma especie que observé en las otras tacuaras, como lo comprobó Mr. Hampson sobre ejemplares auténticos. Es, pues, exacta la determinación que oportunamente dí a los interesados.

Para creer que el parásito pueda influir en apresurar la floración del takuapí, sería necesario admitir que sólo el tambú tiene tal privilegio; para mí esto no es admisible, primeramente, porque en años normales las cañas maduras suelen estar agujereadas y llenas de parásitos por larvas de otros insectos, y luego, porque florecen aun las plantas sin parásitos.

La duración de la vida del takuapí parece más larga que la de la tacuara y más aún para repoblarse los tacuapizales. Furtado, hablando de la tacuara kihsé, refiere que en tacuarales muertos hace más de 40 años, hoy lejos de reponerse, sólo se encuentran raras plantas perdidas en la maleza. Al observar lo que pasa en el Alto Paraná, estoy por creer que aquí va a pasar la misma cosa. Después de la muerte del tacuapí, he tenido ocasión de recorrer hasta el Ihgatimí (Matto Grosso), y en 1913, durante unos meses, por el valle del Río Mondaíh, todos lugares que en otros tiempos he visto poblados de densos

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tacuapizales y hoy reemplazados por otras plantas invasoras de la misma familia. Raros grupos y plantas de takuapí, que se notan acá y allá, tendrán que vencer en un larguísimo número de años a los invasores que ahogaron a la mayoría de las plantitas, pues se trata, a mi ver, de uno de los maravillosos ciclos establecidos por la naturaleza.

A pesar de que he descubierto un gorgojo que ataca a la semilla de takuapí, había germinado con sobrada abundancia en muchas partes. Los obstáculos que han sobrevenido, son los siguientes: En la región del Mondaíh y en los bajíos del interior, las escarchas sorprendieron a las plantitas muy tiernas, dejándolas aniquiladas. En otras partes la semilla no ha podido germinar debido a la espesa capa de cañas y hojas secas; y, en la mayor parte de los casos el terreno desalojado por el takuapí fué rápidamente cubierto por las plantas invasoras, que cubren completamente el suelo, como el takuarembó, el pitinga, takuapí (Olyra) y otras plantas, según el lugar. De suerte que el naturalista que hiciera la geografía botánica poco después de la desaparición de un tacuapizal, se vería obligado a hacer notables modificaciones respecto a las plantas predominantes en la primera categoría de la vegetación de los bosques del Alto Paraná.

La floración, al menos de algunas especies, se ha verificado por regiones, comenzando por el norte. El tacuarembó fructifica y muere poco antes que la takuara grande, a la altura de Puerto Bertoni, pero sucedió varios años antes en la costa brasilera del Guairá. Además, la muerte del takuarembó es aún parcial y se repone fácilmente en muchas partes. Del takuapí, takuarembó y dyatevó se ha hallado rarísimas cepas en flor también en años normales. En el primero fué seguida de la muerte y no noté parásitos.

Las tacuaras en cuestión, que, además de la perspectiva de explotación industrial, son de innumerables aplicaciones en la vida del campo, han producido abundante y fecunda semilla y su cultivo es económico y facilísimo. En tales condiciones, con una medida sencilla se hubiese evitado a una gran región de nuestro país privarse por largos años de elementos tan útiles y logrado antes bien propagarlos en las demás comarcas, fomentando el cultivo. Al Estado fácil le hubiese sido acopiar semilla en gran cantidad y distribuirla a los agricultores. El Departamento de Fomento[1] ha nacido tarde para unas especies. En cuanto a la tacuara grande, ha sorprendido a nuestra oficina en su cuna, en una época de cruel lucha y con un presupuesto tan reducido, que la obliga a postergar sus mejores ideales de progreso. El mismo descuido se observó en la Argentina y Brasil.

Excusado es enumerar las conocidas aplicaciones de las tacuaras, tanto en la industria como en la vida práctica del campesino. En cuanto al lado científico, es mi intento volver sobre el asunto, aún muy poco conocido.

BIBLIOGRAFÍA.

CABEZA DE VACA, Coment., Valladolid, 1555; edic. A. Bertrand, París, 1837, pág. 69.

A. DE SAINT HILAIRE, Voyages, Rio et Mainas, 1830, Vol. IV, p. 432.

H. BURMEISTER, Reise nach Brasilien, 1853, pág. 65; Idem, Atlas Descr. phys. R. Argent., 1879, pág. 61.

A. MIRANDA RIVEIRO (notas de Basilio Furtado), A Lavoura, vol. VII, 1903, pág. 299.

BERTONI, Agronomía, Vol. IV, 1910; Id. Bol. Dep° de Fom° N° 7.

R. VON IHERING, dos artículos del diario O Estado de São Paulo.

[1] El Departamento de Fomento del Paraguay.

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# FOREST PROBLEMS AND ECONOMIC DEVELOPMENT IN SOUTH AMERICA.

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The physical conditions of South America clearly indicate that her great future lies not so much in manufacturing industries as in the development of her agricultural, timber, and grazing resources. South America's natural resources form the basis of all her future development; their conservation, therefore, must be a matter of great national concern. Intelligent utilization of any natural resource requires an intimate knowledge of its nature and extent, its possible uses, and, in the case of a renewable resource such as forests, the method of its perpetuation. This means the application of scientific methods to the study of these resources. As has already been demonstrated in many of our industries, this is the only truly practical way of approaching any problem.

Of these resources the forest must be considered among the most important, both because of its extent and because of the wealth of species and the many valuable by-products, such as rubber, dyestuffs, tannin, and other substances which are derived from the tropical trees. The forest area of South America forms about 38 per cent of the total land area and in its vastness exceeds anything known in North America or any other continent, with the possible exception of the Russian taiga in Asia.

Probably in no other country in the world do there exist such vast possibilities for forest investigations as in South America, which has forests of every kind, from the moist, damp vegetation of the Tropics to the coniferous forests of southeastern Brazil and of the Andes, between which is found every intermediate vegetation.

To show how the application of the science of forestry may be helpful in the development and in the conservation of the forest resources of South America it is necessary first to understand the nature of the problems involved. The forest problems of South America are intimately bound up with the function of the forest—(1) as a source of raw material, (2) as a regulator of stream flow, (3) as a regulator of climate, and (4) as an object of silvicultural management.

## 1. AS A SOURCE OF RAW MATERIAL.

The most obvious and perhaps the most important function served by the forest is to supply raw materials used in the industries. In temperate countries wood is, of course, the chief material produced, its by-products, such as turpentine, bark for tannin, or sugar, being of minor importance. In tropical forests, however, the by-products, such as rubber, dyestuffs, and tannic acid, are frequently more important than the wood itself.

South America as a whole is deficient in coal deposits and other mineral fuel and possesses only a limited and localized source of water power. Wood, therefore, must be not only the chief source of building material, but also the main source of fuel in a large part of the country.

The kind of wood which is most in demand at the present time for general use is a light, strong, easily workable timber which can be supplied in large quantities at a comparatively low price. The value of the South American

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forests depends both upon the number of species which can be found to possess such properties in the wood as will render them useful for many purposes and upon the discovery of other properties whose chief value will lie, as in the case of quebracho or Brazil wood, in the tannin, dyestuff, or other chemical substances needed in industries.

It would seem, therefore, that a survey of the forest resources of the country is necessary, together with a thorough study of the different species composing her forests and of their technical properties. The tropical forests of the Philippine Islands are a good illustration of the wisdom and practicability of such a study. A few years ago they were considered by many of little commercial value, because of the difficulty and costliness of logging vast areas for a few valuable species that might be found scattered through them. Closer acquaintance with the species and a study of their properties disclosed the fact that the forests of the Philippine Islands and the entire Indo-Malay region contain a large number of species, originally considered forest weeds, which possess all the qualities of the temperate hardwoods that are so extensively used for interior finish, furniture, and similar purposes. The discovery of a large number of such species made profitable the exploitation of the tropical forests because of the heavier cut per acre, and placed the entire tropical forests of the Philippine Islands and Indo-Malay region on a new commercial basis. Even if the tropical forests of South America should never become the source of timber supply because of the weight of the wood and difficulty of lumbering, they still represent an enormous wealth because of their richness in by-products. The field opening out in the study of the commercial value of the different by-products of the tropical forests is of almost incalculable extent and of the highest pecuniary value. The investigations may include the study of the properties of the oils contained in woods and in the bark and seeds, of the tannins and gums and their marketable supply; of seeds and fruits, such as Brazilian nuts or sapucaia (Lecythis ollaria); of Piassava palm fiber for the manufacture of brooms and brushes; softwoods for the manufacture of paper, matches, etc.; of bamboos for paper pulp, umbrella handles, sticks, canes, and fiber; of dyewoods which, before the discovery of the cheaper aniline dyes, were among the most valuable products of the country; and so on.

A very striking example of the value of scientific research in the exploitation of natural resources is the discovery by a research staff at Periadeniya, Ceylon, of wound response in Hevea rubber trees, a genus which also occurs in South America. It was found that the production of latex is greatly stimulated in the immediate neighborhood of wounds, so that by continuing to tap successively on the edge of existing wounds a greatly increased yield is obtained. The recent enormous improvement of the rubber industry in the East and the high yields obtained are largely, if not entirely, the outcome of the discovery of this simple phenomenon of wound response.

The direct financial results secured from the application of the scientific discoveries made by the United States Forest Service fully justify expenditures for research work in the field of forest utilization. Thus, through the work of the forest-products laboratory, the solution of the problem of prevention of sap staining of lumber secured a saving to the lumber industry of over $8,000,000 annually; pulp and paper investigations within recent years have shown the value of about 13 species of American timber for the manufacture of groundwood pulp; the studies in the distillation of hardwood timber showed that with no increase in the cost of equipment or operation of a commercial plant, the yield of wood alcohol and acetate of lime may be increased approximately 30

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per cent and 15 per cent respectively. One company which adopted the new method has demonstrated that it could save by this method over $40,000 a year. The data secured by tests of the mechanical properties of wood are being used as a basis for grading structural timbers for a revision of building codes by engineers and building contractors employing structural material, and in employing the proper design for a great variety of products, such as spokes, wheels, boxes, etc.

If forest investigations in such a country as the United States where the trees are comparatively well known and have been for a long time used in various industries are capable of increasing enormously the usefulness of the woods and the products that may be derived from them, how much greater field then exists in South America where the species are hardly known botanically?

### 2. AS A REGULATOR OF STREAM FLOW.

The function of the forest in regulating the flow of streams is second in importance only to its function as a producer of wood and other raw materials. On the one hand, it prevents such calamities as floods, erosion, and silting; and on the other, it conserves the water for domestic use, irrigation, power, and navigation.

It is now a matter of pretty general agreement that the forests in a mountainous country are conservers of water for stream flow, that they increase underground storage of water to a larger extent than any other vegetable cover, and that although forests can not prevent floods, which are produced by exceptional meteorological conditions, they tend to lessen their severity and destructiveness. The function of the forest is undoubtedly as important in South America as in any other country. Mr. Bailey Willis, as a result of several years of study and exploration in northern Patagonia, unreservedly states that the important service for which the Andean forests should be conserved is that of regulating the streams which flow from the Cordillera across the eastern semiarid region of central Argentina. They cover the mountain ranges, where the annual precipitation is very heavy, a large part of it falling as snow. The dense growth of the Andean beeches and cedar protects the ground and prevents the rapid run-off in the streams. Even as it is, there are great floods and in summer corresponding scarcity of water; but if these forests be stripped from the steep slopes of the Andes the floods will be greatly aggravated, and the waters available for irrigation will be so diminished that the valleys, which should become the seat of a dense and prosperous population, will be left to the solitary sheep herder and his flocks.

What is true of Argentina is equally true of Chile. Half the land now cultivated in Chile is watered artificially, and much of the land waiting to be planted must be irrigated before it will yield profitable crops. From Coquimbo to the Bio-Bio River the extent of cultivated areas and the yields of crops depend largely on the supplies of water for irrigation. A beginning has been made of storing water and of constructing engineering works for its distribution. Large irrigation projects, in most cases involving storage dams in the Andean Valley, would make available for crops extensive areas not now planted. Although many of the streams are snow fed, the ruggedness of the mountain slopes makes the danger of erosion and the destruction of the low-lying fields, in case the forest is removed, extremely great.

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In discussing the water power of the Cordillera, Mr. Bailey Willis states again that the effect of the forests in regulating the flow of the rivers in the Cordillera is equivalent to the conservation of 1,700,000 horsepower, which, in view of the industrial future which the region will have, may be capitalized at $170,000,000 gold. In the valley of the Rio Negro the Government is now spending many millions in irrigation works, and the lands under irrigation are valued there at more than 200 pesos paper per hectare. That development is founded on the waters of the river, which in turn depends for its regular flow on the forests.

Water power is now being developed in numerous places also in Chile. The amount of water power in Chile is enormous, and in the absence of mineral coal the introduction of cheap hydroelectric power is essential to the development of manufacturing industries already established in a number of centers; and the forests are just as indispensable for the proper utilization of this enormous water power as for irrigation works, yet large areas originally forested have already been cleared for crops, especially in the valleys. As a result of lumbering the actual forest area has been reduced to 75,000 square miles, or about one-fourth of the country.

The importance of the forests for the irrigation and water-power interests of South America, as well as for the control of floods, makes the protection of all critical watersheds a matter of imperative necessity. No country can develop a sound national-forest policy which does not take into account the protective value of the forests, or lacks knowledge of where the forests are located or the extent of their influence. The influence of the forests upon the regulation of stream flow is no longer a theory. The experience of the old European countries—France, Switzerland, the Tyrol—furnished conclusive proof of the effects that follow forest destruction and the enormous expense involved in attempting later to correct the evil. In the United States of North America the service which the national forests alone perform in the conservation of water for irrigation has been estimated at $2,500,000 annually. As a matter of fact, one of the main purposes for which part of the public domain has been set aside as national forests, and for which $11,000,000 have been appropriated by Congress for buying private forests, is to secure favorable conditions of water flow.

### 3. AS A REGULATOR OF CLIMATE.

The forest has also a marked influence on the climate of the area occupied by it and that of the territory in the lee of it.

There is a close relationship between the climate of the country and the extent and distribution of its forests. On a continent a large portion of which is in the Tropics and which abounds in low land such as the Amazon basin, the part which forest plays in the climate and the salubrity of the region is of vital importance. South America in the general outline of its continent and distribution of the principal mountain ranges resembles very closely North America. Like North America, it is wide in the north and narrows down toward the south, and has a similar arrangement of its principal western mountain ranges; in the east there is a close similarity in the arrangement of the secondary mountain ranges; thus, the Brazilian highlands correspond very closely to the Appalachian Mountains and the Guiana Plateau to the Canadian Plateau. There is no other continent on which the climate retains a maritime character for such a long distance from the shore as that of South America between 10° of northern latitude and 20° of southern latitude, and from the shores of the Atlantic to the eastern foothills of the Andes. This climate is

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without doubt due to the prevailing moist easterly winds which pass over the vast forest area and cause most of the rainfall. There are many reliable indications that the forests in the path of the prevailing moist winds play an important part in causing the moisture to be carried farther into the continent. When moisture-laden winds from the Atlantic Ocean reach the land and encounter irregularities, they are cooled and begin to lose part of their moisture in the form of precipitation. As long as the air currents remain saturated with moisture, the slightest cooling or irregularity of the land that causes them to rise will result in precipitation; but as they move inland and become drier the remaining moisture is given off with difficulty and precipitation decreases. The sooner the humid air currents over land are drained of their moisture the shorter, of course, is the distance from the ocean over which abundant precipitation falls. If precipitation over land depended solely upon the amount of water brought by the prevailing winds directly from the ocean, rainfall would, of course, be confined to a narrow belt close to the sea. Not all the water that is precipitated, however, is lost from the air current. A large part of it is again evaporated from the land into the atmosphere. The moisture-laden air currents, therefore, soon lose the moisture which they obtain directly from the ocean, but in moving farther into the interior absorb evaporation from the land. Hence, the farther from the ocean, the greater is the proportion which evaporation from the land forms of the air moisture. In fact, at certain distances inland practically all the moisture of the air, or at least as great a part as that formed originally by the water evaporated from the ocean, must consist of that obtained by evaporation from the land.

It has been shown beyond any doubt that the evaporation from a vegetative cover, especially a forest cover, is greater than from a water surface or moist, bare soil. The enormous amount of moisture which a forest gives off into the air may be compared to clouds of exhaust steam thrown into the atmosphere, and must necessarily play an important part in the economy of nature. The prevailing easterly winds, taking up the moisture given off by the forests, carry it farther into the interior, and thus bring about a more uniform distribution of precipitation over the continent. This effect of the forests in the path of prevailing winds may probably be found in the case of the forests of the coastal plain of North America, which lie in the path of the prevailing moist southerly and southeasterly winds blowing from the Gulf of Mexico, and probably hold equally true in the case of the forests of Sweden, which lie in the path of the moist, easterly winds of Europe, and which, therefore, must have an important influence upon the precipitation of the countries to the east of it.

A well-known meteorologist (Woeikov) has shown that the amount of water given off by tropical forests into the atmosphere is enormous; and that this evaporation to a large extent explains why in the vast tropical forests of the Amazon River the temperature of the air never becomes as high as it is even in middle latitude. According to Woeikov, the middle and upper extensions of the Amazon River are about 621 miles from the Atlantic Ocean and are separated from the Pacific Ocean by very high mountains. At such great distances from the ocean and so close to the equator, one would naturally expect to find very high temperatures and great dryness. Yet, there the average temperature of the warmest month and the absolute temperature maxima are not greater than at the sea, and even not as high as the temperatures often experienced in middle latitudes. In the following table is shown the temperature and relative humidity at different points within and outside of the Amazon River Basin.



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*Temperature and relative humidity in Amazon River Basin and at points on or near the coast.*

| Locality. | Altitude. | Latitude. | Distance from Atlantic. | Mean annual. | Temperature average for the warmest month. | Absolute maximum. | Annual mean relative humidity. |
|---|---|---|---|---|---|---|---|
| | *Feet.* | ° | *Miles.* | °*F.* | °*F.* | °*F.* | *Per cent.* |
| Para | | 1½ | 62 | 80.6 | 81.86 | | |
| Manaos | 121 | 3 | 714 | 78.98 | 80.6 | 97.26 | 80 |
| Iquitos | 311 | 3½ | 130 | 76.64 | 78.26 | 90.32 | 83 |
| Pernambuco | 11 | 8 | | 78.26 | 80.78 | 89.06 | 72 |
| San Antonio on the Madeira | | 9 | 1,067 | 78.8 | 80.6 | | |

Woeikov attributes this remarkably moderate temperature of the Amazon River Basin to the cooling effect of the forest. He assumes that in tropical countries, covered with luxuriant forest vegetation, the rainfall is seldom less than about 50 inches a year. So thick is usually the mass of decayed leaf litter and fallen and half-rotted trees in the forest that most of the rainfall is absorbed by the soil, and only a small portion runs off from the surface. Even allowing one-third of the annual precipitation for surface run-off, there is still transpired by the plants and evaporated by the soil a layer of water about 40 inches high. About 35.5 cubic feet of water are given off from every 10.7 square feet, and in the evaporation of this amount of water 606,500 calories of heat are consumed. It is self-evident that the absorption of such enormous quantities of heat from the atmosphere must tend to moderate the temperature prevailing in the Amazon Basin.

#### 4. AS AN OBJECT OF SILVICULTURAL MANAGEMENT.

Studies of the commercial value of the South American timber resources and of the effect of forest cover upon climate and stream flow will provide a basis for determining the national economic importance of South America's forest wealth. There still remains, however, the entirely untouched field of the actual management of the forests, of how to grow and care for the forest, how to perpetuate the valuable species and eliminate the inferior ones, and increase in general the productivity of the forest. There are constantly growing fears that if the present methods of cutting quebracho forests are not modified and measures are not adopted for its re-growth there will be little left of them in a very short time. The same is true of the greenheart and of the mahogany, of the Spanish cedar and Parana pine, and of other valuable South American species. To work out methods of proper forest management for such a large number of species as are found in most of the South American forests, one must not only know them botanically but must also know their life histories, their requirements for light, soil, and moisture, their enemies, and diseases. This is a field in which practically nothing has yet been done in South America. Even the botanical identity of some of the commercial woods is not fully known, still less their distribution, their growth, and life requirements. Yet the climate of South America, at least of the Amazon Basin, affords the most wonderful opportunity for growing timber crops of the most valuable kind. In such a climate the practice of forestry in the Amazon Valley could bring forestry nearer to the level of an agricultural crop than anywhere else. While in the north and temperate regions it takes many decades for a timber tree to reach usable size, in the moist and warm climate of the Amazon Valley this could be accomplished within probably 25 or 30 years.

It is impossible to go on with the improvements of the forests or to begin planting pure stands of some valuable species and overlook the danger to which

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they may be exposed from insect depredations or attacks by fungous diseases. Research alone can render us prepared against such depredations; and it is only when the life history of the insects and the fungi is known that means are found for combating them.

The solution of the forest problems outlined here can not be accomplished, of course, in a year or two years, even with concentrated efforts. In attempting such investigations it must be borne in mind that a narrow-minded view that $1 spent on Monday should produce $2 on Tuesday is an unreasonable one. The time taken for forest research to show a monetary profit must of necessity depend on the subject dealt with. The ultimate gain to the country through the appreciation of the economic importance of the forest and the adoption of rational methods of forestry has been amply proved in Europe and the United States of North America. The adaptation of similar methods to the varying conditions of climate and vegetation in South America, wherever they can be successfully introduced, is a matter of the greatest importance from a financial standpoint, and expenditures on forest research are more than justified.

Europe and the United States also point out the way to approach scientifically the solution of the forest problems. It has been the experience of all the countries which attempted to place the exploitation of their forests on a scientific basis that this can be best accomplished only by means of forest experiment stations. Forest experiment stations have accomplished for the science and practice of forestry what the agricultural experiment stations have accomplished for the science and practice of agriculture. If the experiment-station idea has been found essential in the study of agricultural crops which are, as a rule, plants with a short cycle of life and therefore lend themselves to short-time observations, how much more essential is the experiment-station idea in connection with timber trees whose life cycle extends over a number of decades and often over several generations of men. The experiment-station idea really means nothing else but systematic observations over a long period of years properly recorded and properly interpreted by an especially trained and scientific staff, instead of sporadic observations without any system or organization.

The forest experiment station idea is not a new one. The value of the systemic organization of forest research work was officially recognized in Germany in 1870, when the first forest experiment station was established in Baden, in connection with the Polytechnikum at Carlsruhe. Half a dozen of the German States followed the example, instituting main experiment stations in connection with forest schools, and branches in various forest districts. The cost to the German Government is in the neighborhood of $30,000 annually. The work done is intensely scientific, and the policy of forest experiment stations is steadily growing in favor. In India, where the work of research has been neglected for a long time, the need for scientific investigation has now been recognized by the Government, and an Imperial Forest Research Institute and College has been created at Dehra Dun, with a faculty chosen from the Imperial Forest Service. In the United States considerable research work has been done in connection with forest problems. The beginning of real investigative work in silviculture, however, must date from the establishment of the first experiment station at Flagstaff, Ariz., in the summer of 1908. Advantages of economy and greater efficiency in conducting investigative work in silviculture at an experiment station are apparent. Under the old system of conducting investigative work, assignments to an extensive area were usually necessary, to which the observer could devote but a short field season. Under the system of forest experiment stations, specially trained men are permanently assigned

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to a given region with which they have an opportunity to become thoroughly familiar and therefore are capable of conducting the work with the greatest effectiveness and least expense. Each of the experiment stations is allotted an area sufficient for the proper handling of short-period experiments, for experiments requiring a number of years, and for the maintenance of large permanent sample areas which serve as models typical of the silvicultural region. Such areas furnish the most valuable, instructive, and convincing object lessons for the public in general, for professional foresters, lumbermen, and owners of forest land, and especially for the technical and administrative officers of the national forests.

The organization of the forest experiment stations made possible the use of uniform methods in dealing with forest problems. General problems are treated at the different stations simultaneously; local problems in the region to which their results apply. All of the modifying factors which enter into the results of experiments are measured by observations covering many conditions and years and are thus determined once for all with the greatest economy and the least duplication of work.

The stations are distributed in such a way that one station is located in each of the silvicultural regions of the West. A single forest, representing as much as possible the conditions typical of the region, is selected, and a portion of this area set aside for the purposes of the experiment station.

The United States Forest Service is now maintaining a large and well-equipped laboratory in forest products at Madison, Wis., three forest experiment stations in the central and southern Rockies, two in the Sierras, one in northwest Idaho, and one in Oregon. In addition, one experiment station is being maintained in Minnesota in cooperation with the University of Minnesota.

The establishment of experiment stations and inauguration of research work in forestry, however, is impossible unless there exists some forest organization in each country for the protection and administration of at least the Government timber resources. Before scientific work can begin, there must be an awakening of public opinion to the importance of forest protection in general, the value of the forests to the Nation, and the need of developing better methods for their perpetuation. Unless such investigations are backed up by an awakened public opinion, and there are various Government organizations which can utilize the discoveries of the scientific staff, and apply them to the actual exploitation of the natural resources, the investigations will remain largely academic without any practical significance and will accomplish comparatively little good. Fortunately for most of the South American countries much of their timber is still in the hands of the Government, and, therefore, the opportunities for developing a national forest service to undertake scientific investigations in the various forest problems are good. In some countries, like Argentina and Chile, the first beginnings in this direction have already been made.

## SCIENTIFIC FORESTRY FOR LATIN AMERICA.

By BARRINGTON MOORE.

### IMPORTANCE AND MEANING OF FOREST CONSERVATION.

The importance of conserving the forests has been demonstrated by the experience of all nations. It may, therefore, be accepted that every enlightened

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nation, as soon as it sees its forests in danger of destruction, will take steps to avert this danger.

Conserving the forests does not mean reserving them from use; it means perpetuating them by wise use. This means, briefly expressed, treating the forest as a growing crop instead of as a mine which, when exhausted, is abandoned. The old trees are cut in such a way that the land becomes restocked naturally with young trees, which are allowed to grow until they in their turn are ready to cut and to restock the land; if the land does not become restocked naturally it is restocked artificially. Forest conservation is necessary only on land unsuited to agriculture, because ordinary farm crops are generally more valuable than trees, except for certain very rapid-growing and valuable trees.

### WHEN TO BEGIN FOREST CONSERVATION.

The time to start wise use of the forests is in the early stages of the demand for forest products, before the destruction has proceeded too far. The damage, once done, is costly and sometimes impossible to repair. In steep mountains the destruction of the forests permits the rains to wash away the soil which was held in place by the trees and in which the trees grew; therefore, in such places the forest can not be replanted for there is no soil in which it can grow. Parts of the French Alps and the Karst region of Austria are examples of this kind of destruction. In less steep places, where the soil remains after the forest is destroyed, it is still extremely difficult and expensive to reestablish the forest for the land becomes overgrown with dense bushes, rank weeds, or coarse grass which effectively prevent the growth of trees, and which can be eradicated only at prohibitive expense. In the northern part of the Sierra Nevada Mountains of the western United States there are thousands of hectares of brush land which was formerly covered with valuable forests. In the Philippine Islands a large proportion of the land which was once forested is now covered with the coarse and worthless "Cogon" grass, which keeps out not only the forests but the farms because of the difficulty with which it is eradicated. Hence the best, and, in many cases, the only time when a forest can be cut in such a way that the land will be restocked with a new forest is at the first cutting.

It is therefore of the utmost importance to begin at the earliest possible moment to learn how to properly cut the forests. Energy and money spent for this purpose now is but a small fraction of that which will otherwise be needed later. The necessity for undertaking forest conservation soon is increased by the length of time required to develop effective methods of managing the forests. These methods can not be learned in a few weeks or months, but require years. They can not be copied except in a general way, from other forestry practicing countries, but must follow the acquisition of knowledge concerning the life history and requirements of the individual species of trees and of the forest as a whole. One may learn certain broad principles from other countries, and a few fundamental laws, but only a few, because the laws governing tree growth are but little known. Nevertheless, it is well to use what the older forestry-practicing countries have to offer, provided one does not imagine that in so doing he is solving the problems of his own country. He is merely making a beginning by preparing himself to undertake their solution.

### RELATION OF FORESTRY TO SCIENCE.

The practice of forestry rests upon scientific knowledge of the trees and their environment, just as the practice of medicine rests upon scientific knowl-

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edge of man and his environment. Therefore, since the practice follows the development of the science, it is necessary first of all to emphasize the scientific side of forestry. It is well to realize at the outset that scientific work in forestry goes far deeper and is more complex than has hitherto been supposed.

The dependence of forest practice upon scientific discoveries, and incidentally the financial gain which these discoveries sometimes yield, may be illustrated by an actual case. In the forests of western white pine in the northern Rocky Mountains the foresters were leaving 25 per cent of the total stand in order to insure natural reproduction of the valuable white pine. This increased the difficulties of the lumberman, because the less he cuts from a given area the more it costs to secure a given quantity of lumber. It also meant the leaving on each hectare of approximately $52 worth of timber which would probably decay or blow down before it could be utilized at a second cutting of the same land.

This involved, therefore, a loss of $52 per hectare to the owner—in this case the Government. When western white pine had been studied a few years, it was found that there was an abundance of seed in the moss under the forest—seed which did not germinate while the parent trees were still standing, but sprang up as soon as the forest was cut. This discovery made it unnecessary to leave so many seed trees. Now only 10 per cent of the stand is left to make sure, and the remainder is cut. In this case science has shown a different and better method of cutting, and incidentally increased the revenue from these forests by about $35 per hectare.

Scientific work should be started as soon as there is a forest organization, even though this organization consists of but two or three men. In tropical forests it is of far more importance to start scientific work early than in temperate forests. The reason is that in tropical forests it takes much longer to secure the growth data required in forest management. Since tropical trees generally do not show annual growth rings as do trees in temperate regions, it is impossible to determine their age by the commonly used method of counting rings on the stump. The only method of determining growth in tropical forests is by means of permanent sample plots on which the growth of the trees is determined by accurate measurements at intervals of five years or less. This method has been used successfully in the Philippine Islands and is described in the Philippine Journal of Science, section A, volume 9, Nos. 5 and 6, 1914. Since this method takes time it is of the utmost importance to establish the sample plots as soon as possible. These plots should, of course, cover a wide range of conditions in regard to the size of the trees, species of trees, and soil.

### COOPERATION BETWEEN FORESTERS AND BOTANISTS.

A large part of the early work will be botanical, because of the large number of trees and other important plants which must first of all be described and named. Cooperation with some botanical institution is therefore essential. Fortunately South America has already done excellent work in botany, and has several botanical gardens which are famous throughout the world. Cooperation between these botanical institutions and the forestry organizations will be of value to both. The foresters during their reconnaissance of the forests collect specimens formerly unknown, thereby adding to the botanical knowledge and enriching the collections, while the botanists render invaluable assistance to the foresters by describing and classifying for them the trees and plants which they must know. An example of the mutual benefit of this cooperation may be seen in the Philippine Islands in the joint work of the bureau of science and the forestry department. The progress made by these two organizations has been remarkable.

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DEVELOPMENT OF SCIENTIFIC FORESTRY.

The scientific work of forestry must, like everything else, develop gradually from lower to higher forms. A country taking up forestry for the first time can not, as a rule, take up the work in the stage of development reached by the older forestry-practicing countries, although it may profit by the experience of these countries to shorten the time of development. For convenience the development of scientific work in forestry may be divided into three stages. But we must not think of these stages as sharply delimited. One stage begins before the work of the preceding stage is half finished, and the third stage generally starts while some work under the first stage is still going on.

*Stage of observations.*—The first stage may be called the stage of observations. This occurs when practically nothing is known of the forest, either about the life requirements of the trees or about the climatic and soil factors which control the forest. Every forester and every botanist who goes into the woods finds something new. Their observations are generally only incidental to the other work, such as the classification of species and the location of the more important bodies of timber. Occasionally some information is gathered independently of other work in the course of a short general study, usually undertaken without much plan. All these observations, fragmentary and unrelated though they be, are none the less valuable. In British India, until a short while ago, practically all of the information concerning the life history of the forest came from the observations secured by forest officers while drawing up plans of management or in the course of their other work in the forest. In the United States a large part of the accumulated information on which the management of the forests is based to-day comes from incidental observations.

An example will illustrate these observations. The reproduction of species A is found only under shade; that of species B only in openings. If species A is the more valuable of the two, the cutting should be so arranged that some shade be left to insure the reproduction of species A; if, on the contrary, species B is more valuable, the cutting should leave openings in which species B can reproduce.

Thus these observations supply a basis for working out methods for cutting the forest. These methods will, of course, not be the best ones possible, but if made conservative will allow the use of the forest resources without destruction of the forest. They can gradually be improved as increasing scientific work gives increasing information.

It is therefore of the utmost importance that every man who enters the woods, whether he be forester or botanist, should keep his eyes open and his mind constantly on the alert to see and correlate everything which may possibly have a bearing upon the life of the forest as a whole or on the life of the individual trees which make up the forest. It is of almost equal importance that all observations, deductions, and hypotheses be written down fully without delay; for it is only when one puts pencil to paper that one's thoughts become clarified and that one sees new factors and relationships which otherwise would have been overlooked. Furthermore, each man should feel it his duty to periodically work over, digest, and correlate his notes and to publish the resulting facts and conclusions in clear readable form, so that his observations will be permanently recorded and made available to others.

The making of observations should be not only a stage in the development of scientific forestry, but a permanent part of a forester's life. In the early stages observations must be relied upon for the bulk of the information needed in handling the forests; in the later stages observations serve to suggest improvements in methods, new lines of research, and also to maintain that alertness of eye and brain which is so necessary to a forester.

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*Stage of special studies.*—The second stage is that of the special studies which are undertaken after a reconnaissance of the forest resources has begun to give some idea of what the forests contain and of which trees are likely to be valuable. This stage overlaps the first in that it starts while incidental observations are still supplying the bulk of the scientific information. The chief distinction is that the special study represents a definite effort, thought out and planned beforehand, toward securing certain desired facts, while observations under the first stage are generally only incidental to other work or are merely rough studies without definite plan. The special study is therefore an advance from haphazard to systematic acquisition of data.

The work characteristic of this stage is the special study of an important tree species or forest association carried on by one or more men who are in the field during one or two seasons for this special purpose. These men are attached to a central office, in which they work up their reports, and are sent wherever the desired study is needed, even though it may be at a great distance from the central office. For example, suppose you want to know how to cut quebracho trees in such a way as to insure a permanent supply of this valuable wood instead of allowing indiscriminate cutting, which sooner or later will probably exhaust the supply forever. You send a party of trained men, or one trained man in charge of a party of students, into the quebracho-producing regions to make a special study of this tree. He finds out all he can about the requirements of the tree in regard to soil, moisture, and light; whether it grows naturally on rich or on poor soils, whether it requires much or little moisture, whether it can live under the partial shade of other trees or must have full sunlight. He studies the reproduction of the tree as much as his time and facilities permit; he learns as much as he can about the quantity of seed which trees of different sizes bear, the fertility of the seed, distance it is disseminated, and agencies of dissemination (wind or animals, etc.), frequency of heavy seed years, and the conditions necessary for the seed to germinate and the young trees to become established. He also secures as much data as possible on the rate of growth of individual trees and stands; this he can obtain only if the tree makes annual growth rings, otherwise he must establish sample plots and forego the growth data until these plots can be remeasured. He must also determine the dangers and injuries to which the tree is or may be exposed; what are its fungus and insect enemies and the extent of the damage they cause; whether, when the overhead canopy is removed, the trees of the second story will die, as in the case of the dipterocarp forests in the Philippine Islands;[1] or whether the trees which may be left for seed will be overthrown by the wind; the likelihood and effect of fire; and any other dangers to which the forest may be exposed. He should also determine, as far as possible, whether the stand is even-aged; that is, whether all the trees are of roughly the same age (within 20 to 50 years in mature stands) or whether trees of all different ages grow mixed in together.

All the information above mentioned, and more besides, is indispensable in the development of proper methods of using the forest. Until natural reproduction and all the factors related to it are understood, how is it possible to cut the forest in such a way as to be sure of securing natural reproduction of the desired species? It is, of course, impossible within the limitations of a special study to learn everything, or even more than a small fraction of the information necessary for the most effective handling of the forest. The special study will, however, permit the development of methods infinitely better than unregulated cutting or than regulated cutting without information.

[1] Brown, W. H., and Mathews, D. M., "Philippine dipterocarp forests," Philippine Journal of Science, vol. 9, sec. A, Nos. 5 and 6, 1914.

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During the stage of special studies there may be established a research institute, as at Dehra Dun in British India. If this is near a forest, part of its work will be that of an experiment station, and to all intents and purposes the research institute may be considered as an experiment station. But the bulk of the work still consists of special studies in one locality or another, often at great distances from the institute. For this reason the establishment of a research institute may be considered as a transition between the special studies and the stage of experiment stations, possessing some of the characters of both stages, but belonging chiefly to that of the special studies.

All the data secured by observations and special studies should as soon as possible be brought together, worked over, and built into monographs or other suitable publications covering the different species or forest associations. These publications represent the sum of information to date, but do not by any means signify that the information is complete. They merely bring it together into a form which insures its fullest use by those who need it most (the men managing the cutting in the forest) and which will stimulate the collection of additional data by showing the phases in which the present data is weak or lacking.

*Stage of experiment stations.*—The third and final stage is the stage of the experiment stations. Only when this stage is reached can true scientific research in forestry be carried on. The observations and general studies serve a valuable purpose and are not to be disparaged, but can under no conditions take the place of experiment stations.

The establishment of experiment stations marks the change from studies which ascertain the nature of the phenomena and find a few readily understood causes to research which aims to discover the deeper causes and to establish the fundamental laws governing the forest.

*Advantages of experiment stations.*—The experiment stations have many advantages over the special studies, some of the more important of which are as follows:

(1) Economy: The special studies often require heavy traveling expenses, particularly when they must be carried on at some distance from headquarters, and must cover large areas. This expense is avoided by experiment stations located in the regions to be studied.

(2) Efficiency: It oftens happens that in writing up a report on a special study some of the data is found to be insufficient or unsatisfactory. With the experiment stations such deficiencies can easily be remedied because the investigator is constantly near his forest.

(3) Familiarity with the forest problems of a region is increased by having a man permanently assigned to the region.

(4) Permanence and continuity of work is insured by experiment stations. This is probably the greatest advantage of all in that it gives an opportunity for securing data obtainable in no other way. It enables the making of continuous records all the year round and year after year covering the factors which control the life of the forest. These records are of fundamental importance for the science upon which effective forest management must be based. Furthermore, permanent work in a single locality permits the installation of delicate instruments which can not be carried about on the special studies, and affords opportunity for the experimenter to devise and try out instruments of his own. This allows the measurement and study of important factors which would otherwise remain unknown.

These are the immediate advantages which the experiment stations give in the scientific work itself without mentioning the saving of money afterwards when the results are applied to the management of the forest.

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*When to establish experiment stations.*—The advantages of experiment stations make it advisable to undertake them at the earliest possible moment, but not blindly or with undue haste. They must be the natural outgrowth of an appreciation of the value of scientific work and of a demand for such work. Progress will be more substantial and more rapid in the long run if the experiment stations are established later, when their function is properly understood, than if they are established immediately and not given the necessary support. Before experiment stations can be established there must be a reasonable amount of information concerning the forest resources and where these resources are located. This information will be furnished by the rough reconnaissance of the forest, which is one of the first steps in undertaking forestry. The problems must also have begun to crystallize as a result of the data secured by observation and by special studies. Otherwise it is impossible to select the proper location for a station or to decide upon the work which it should do. It is also necessary that men trained in research work and with a broad conception of scientific forestry be available for assignment to the stations.

*Establishment of experiment stations.*—Once the establishment of experiment stations has been decided upon, as it inevitably must be by every nation which intends to secure permanently the full value of its forest resources, three main questions come up for consideration: (1) The location of the stations; (2) the character of work and equipment; (3) organization and personnel. Each of these questions will be considered separately.

(1) Location of experiment stations: The choice of location for an experiment station is an important matter requiring serious thought, for on the location of the station depends a large measure of its opportunity for work.

The first consideration is the forest region. Other things being equal, the choice should fall upon the region in which the forests present the most difficult problems in natural reproduction, in tree planting, and in other matters of importance in forest management. The region should also be one possessing resources for which there is now, or soon will be, an active demand.

The second consideration is accessibility. The station should be placed as near as possible to lines of transportation, either railroads or navigable streams. Otherwise the cost of bringing in building materials, equipment, and provisions will be very high. Furthermore, we must remember that the men assigned to the experiment stations must live there permanently the year long and year after year, with their wives and children. No man with the high degree of education necessary for this work will bury himself permanently in an inaccessible wilderness; even though he were willing to do so, he could not accomplish good work, because high-grade scientific work requires contact with other scientific minds.

The third consideration is the possession or absolute control of a sufficient area of typical forest to use in experimentation. This area should include, as far as possible, all the important kinds of forests of the region, and should be within a reasonable distance of the station. Since all the important kinds of forest may not occur near the station, it may be necessary to reserve or secure other areas at greater or less distances from the station.

(2) Character of work and equipment: Of first importance in the character of the work of the experiment stations is the point of view regarding the work. It is necessary to choose at the outset between two widespread and conflicting points of view. The first is that of the world at large—that research must aim at solving some definite need, research must be practical and must show results. The second point of view is that of the scientist, who believes that research should seek fundamental knowledge rather than attempt

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to satisfy a specific need. His motives are, however, just as altruistic as those of the men who hold the first point of view, in that he sees the benefit to the world at large which fundamental knowledge brings.

Both points of view aim for progess, the chief difference being that the first seeks for immediate returns and tends toward superficiality, whereas the second goes deeper and seeks the knowledge which, though it may bring no returns at present, lays the foundation for far greater returns in the future. The moving spirit of the second point of view has been admirably expressed by Prof. R. S. Lillie, in Science for April 16, 1915, in a paper which should be read by all foresters undertaking scientific work. Concerning the question we are now considering he says:

It is the fundamental investigations which are chiefly important for science, and lay the foundations for those later applications affecting mankind generally. Thus in this sense we owe wireless telegraphy to Maxwell and Hertz rather than to Marconi, our freedom from many forms of disease to Pasteur, our mastery of the air to Langley and others who studied the lifting power of moving planes; and many other similar examples could be given. In general, we may say that if an adequate body of theoretical knowledge has once been gained, it is a relatively easy matter to make the desired practical applications. It is when there is no guiding theory and we have to work empirically that problems are difficult or impossible of solution.

Foresters have generally been so eager for immediate results that they have failed to see the principle embodied in the foregoing quotation. This holds true even of Germany, where science is so highly developed. Dr. Vater, at the famous forest academy of Tharandt, says that the desire to solve directly the questions arising in forest practice has led to neglect in furnishing the fundamentals necessary for successful experimentation. Forestry has lacked the "adequate body of theoretical knowledge" which Prof. Lillie mentions, and has therefore found many problems difficult and even impossible of solution; most work is still purely empirical. It is hoped, therefore, that Latin America will not fall into the same error, but will strive diligently to contribute to the sum of fundamental knowledge.

The foregoing does not mean that studies of the problems bearing directly on the practice of forestry should be postponed until the fundamental knowledge required for their proper solution has been secured. The acquisition of this knowledge is a slow process requiring years, and meanwhile some data, however imperfect, are needed to show how to cut the forest and how to plant denuded lands. Hence provisional data, which will serve the purpose until they can be revised in the light of more thorough research, must be secured by empirical methods.

You will want two main lines of information—first, how to cut the forest in such a way as to secure natural reproduction of the most desirable species; and, second, how to successfully reforest land at present denuded and unproductive, or forest land where natural reproduction can not be obtained.

The proper methods of cutting are learned by actually trying a number of different methods; careful records made before and after cutting show the effect of each method upon forest conditions, and show the reproduction obtained under each method and set of conditions. It is presupposed that observations and special studies have, before the establishment of the experiment stations, furnished at least some little information which will assist in laying out the methods of cutting and will save the expense of trying methods which must surely fail. For example, if we already know which species are shade enduring and which are light demanding, we need not try methods adapted to shade enduring trees on those which are light demanding, and vice versa.

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Experimentation in methods of cutting should aim to furnish data not only on the best methods to secure natural reproduction, but also on the relation of the tree to its environment. This involves the measurement of all factors of soil and climate which influence the life of the forest. The most important of these factors, as far as we know at present, are soil moisture, the physical and chemical characteristics of the soil, precipitation, relative humidity, evaporation, temperature, and solar radiation.[1] The data on these factors and their relation to the forest will form part of a store of fundamental scientific knowledge which will be applicable in solving innumerable forest problems, not only in methods of cutting but in reforestation and other lines of work.

Experimentation in reforestation is almost indispensable as a measure of economy even if it were for no other reason. Experiments on a small scale, conducted before the regular work of reforestation is undertaken, will show the methods of reforestation which are likely to be most successful. This will avoid the failures and the consequent waste of money which is inevitable when reforestation is undertaken without thorough preliminary experimentation.

The United States has suffered from just such waste. For example, in one forest region 1,950 hectares were planted with trees before reforestation experiments had been carried on. The cost was $117,000. Out of these 1,950 hectares only 30 hectares may be classed as successful. Therefore, the cost of each hectare successfully planted has been about $3,900. The experiments bearing on reforestation cover the handling, storage, and testing of seed, nursery practice (involving numerous experiments designed to find out how to produce the greatest quantity of the most desirable planting stock at a minimum cost), and the best methods and seasons of planting out young trees or sowing seed. The work consists of finding by actual trial the most successful methods, and determining wherever possible the underlying causes. Some of this work, particularly the nursery practice, can be performed by a skilled gardener or farmer, with the exception of the planning, supervision, and study of causes.

The equipment will depend to a certain extent upon the investigations in hand, though some instruments are necessary in almost all investigations. Aside from comfortable quarters for the man in charge and his assistant, there should be primarily a greenhouse and a laboratory. The greenhouse is necessary, even in tropical countries, for experiments in which conditions must be controlled. The laboratory should contain, among other things, a water-jacketed drying oven for determining soil moisture, a high-grade balance, and also equipment for simple chemical and physical tests of soils, unless the latter work is done by some other institution in cooperation with the experiment stations. Among the more important instruments are those for measuring climatic factors, such instruments as rain gauges, wet and dry bulb thermometers, evaporimeters, anemometers, and radiometers (for solar radiation). Self-recording instruments are preferable when their cost is justified.

(3) Organization and personnel: The last, but by no means the least, consideration is the organization and personnel of the scientific work in general, including the experiment stations. Organization will have a certain influence on the work in the earlier stages of scientific forestry, but becomes of far greater importance when experiment stations are established. Good organization will help and poor organization will hinder; but poor organization is worse than none at all because it may do positive harm whereas the lack of organization will merely fail to do good.

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[1] Briggs, L. J., and Shants, H. L. "Transpiration on Clear Days, in Relation to Environmental Factors." Bulletin of U. S. Department of Agriculture, Bureau of Plant Industry, in press.

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The strongest emphasis should be placed upon freedom for scientific work. Without freedom no real progress is possible; the results may satisfy the immediate needs for a time, but will always be superficial.

The necessary freedom can be secured only by making the scientific work a special branch coordinate with the other major branches of forest work. For example, in the Philippine Islands the scientific work was placed in the branch of investigation, a branch coordinate with that of administration. The remarkable progress made in the Philippines would have been impossible had not the scientific work been independent of the administrative work. The central investigative committee of the United States Forest Service in their annual report for 1915 says: "A combination of administrative and investigative activities, with the subordination of either one to the other is more or less harmful to both." An administrative officer has neither the time nor the ability to supervise the details of scientific work. His tendency is to allow the undertaking of only the so-called "practical" projects, and to stop fundamental investigations which bear only indirectly on the problems in which he is interested, but which build the necessary foundations for studying these problems.

The argument in favor of uniting administrative and investigative work—which always means subordinating the investigative to the administrative—is that such a union is mutually beneficial in that it keeps the investigator practical, and keeps alive the interest of the administrator in scientific work. The desire to keep the investigator practical is part of the fallacious point of view of the world at large that science should produce immediate results (see above under "(2) Character of work")—a point of view which fosters superficiality and stifles the fundamental work by which alone science can make progress. The desire to keep alive the interest of the administrator in scientific work is praiseworthy. But the sacrifice of science is entirely too high a price to pay for this interest. When we wish to give a civilian an interest in military matters we do not place him in command of an army. The administrative officer can keep alive his interest in science by reading scientific literature just as well as by interfering with scientists.

The men employed in scientific work, especially the men in charge of the experiment stations, should have a natural talent for science, and a specialized training. They should have an inborn love of knowlege for its own sake, and untiring industry, combined with a broad viewpoint. They should have received training in handling instruments, as well as a thorough grounding in all the subjects which bear upon their work, such as physics, chemistry, geology, botany, biology, and plant physiology, and, of course, forestry. It may be necessary at first to place men with only the general forestry training in charge of the experiment stations. Later on, as the facilities for special training become available, these men should be allowed one or two years away from the experiment stations to acquire the necessary special training, or should be replaced by better men who have this training.

Investigative men will receive the proper training only when the institutions which train foresters take up research work. But it is a mistake to suppose that the research professors at the university or forest academy can do a large amount of teaching in addition to their research work. In India, when the Research Institute was established at the Imperial Forest College of Dehra Dun, it was thought that the regular faculty of the college could add research to their other duties. This was tried but failed and now the teaching required of research men has been materially reduced.

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### RESEARCH IN FOREST PRODUCTS AND ECONOMICS.

Research should include not only studies of the forest, such as those emphasized above, but also studies of the products derived from the forest, and of economic conditions. The foregoing paper has dealt mainly with studies of the forest aimed primarily at securing information which will permit cutting the forest in such a way that it will be preserved and improved as a source of raw materials and of revenue. Studies of forest products and economics, though requiring men with different ability and training, yet have a direct bearing on the management of the forest.

In the field of forest products the aim is to determine the properties of the woods and other materials which come from the forest. This work gives information leading to the best use of each class of material, and discovers new uses for materials formerly considered worthless. For example, the work of the Forest Products Laboratory of the United States Forest Service has shown that a number of hitherto unknown woods are suitable for making paper. Such findings are of value not only to many industries but also to the man who must manage the cutting of the forest. Until the uses of all the different trees are known, it is possible to sell only a small number of valuable species, such as cedar, quebracho, and a few others. This not only makes logging expensive because of the small amount taken per hectare, but leaves the forest in poorer condition, because the valuable trees are removed and the poorer ones left to reproduce themselves.

Economic studies are of importance for the same reason. They furnish data on markets, questions of demand and supply, and other economic matters—data which are invaluable in developing the demand for forest products and opening up new outlets for selling these products. Only through economic studies well applied is it possible to secure complete utilization and full value for the yield of the forest.

### OBSTACLES TO BE ENCOUNTERED.

Scientific forestry always encounters a number of obstacles at the start. These obstacles will vary in different countries, but some will be practically the same everywhere. Two of the most important should be mentioned here because a difficulty which has been foreseen is less discouraging than one which arises unexpectedly. The first obstacle is the strong and natural desire of lumbermen to cut the forest in such a way as to secure the desired product as easily and cheaply as possible, regardless of the forest itself; they look upon the forest as a mine which, when worked out, will be abandoned. Therefore they vigorously oppose that control which the forester must exert over their cutting in order to insure the use of the forest as a growing crop from which only the mature trees shall be harvested. This opposition is particularly strong when, as often happens, the forester's control adds to the expense of their operations. They are more interested, and reasonably so, in obtaining returns on their investment than in preserving the forest.

Opposition against controlled cutting increases in proportion with the risk of the operation. The lumberman, operating under conditions with which he is familiar, feels that he can calculate each item of cost with reasonable accuracy and can deduct from the price he pays for the timber the extra cost imposed by forestry control; hence he does not object strongly to the necessary restrictions. But in new ventures the risk is so great, on account of the many factors impossible to foresee, that nobody will invest his capital unless assured of favorable terms; among the most important of these terms is absolute freedom in methods of operation. Since logging in South America on a large

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scale is a new venture involving a high degree of risk, we must not expect that any lumberman will undertake operations there unless he is assured of entire freedom to cut as he pleases, whether he destroys the forest or not. Experience has shown that unregulated cutting, using modern logging machinery, almost always destroys the forest. Therefore you can be sure that large operations will, for the next few years at least, destroy your forests. And yet, only by large operations can the forest resources be quickly and fully developed. The situation is, therefore, to all appearances, discouraging; the temptation is to abandon all idea of forestry and to get as much as you can for your forests now regardless of the future. In yielding to this temptation you would get but a small fraction of what the forests are worth and impoverish your descendants.

Fortunately there are remedies. The first remedy is to sell timber now only in forests growing on land which, when cleared of forests, can be turned into farms. This is land from which you would sooner or later remove the forests anyhow; hence the destruction of the forest in this case is not a loss. During the operations on this class of land both the foresters and the lumbermen will acquire the information which they will need later on for cutting in permanent forests. Therefore, by the time the forests on agricultural land have been exhausted, you will be in a position to exert the necessary control over cuttings in the forests on nonagricultural land. In this way only on the land suitable for farms will the forest be destroyed, while the land unsuited to farms, which would be nearly valueless if it were not producing trees, will be covered with forests giving protection to stream flow and yielding a steady revenue. In countries which do not have forests on agricultural lands the foregoing does not, of course, apply. The best forest policy in these countries is patience. The granting of large concessions without definite forestry provisions would be suicidal. It is far better to wait a few years with undeveloped forests in order to protect the watersheds which supply water for irrigation, and to insure a permanent revenue in the future, than to suffer the evils attendant upon forest destruction for a mere pittance.

The second obstacle does not, like the first, endanger the entire forestry movement, but it is very serious in that it endangers scientific work in forestry, and thereby threatens to obstruct forest development. This obstacle is the difficulty, sometimes amounting to impossibility, of putting into practice the methods of cutting which science has shown to be the best for the future productivity of the forest. This difficulty generally arises from the character of the market which the forest supplies, and from the methods of removing the timber which are necessitated by topographical features and transportation facilities. The same difficulty applies whether the Government does its own lumbering or whether it sells the trees standing in the forest; the Government can not incur heavy losses in order to do that which is best for the forest any more than it can compel a purchaser of standing trees to bear such losses.

The difficulty is greatest where the character of the market is most restricted, and where rough topography and lack of transportation render the placing of the timber on the market most expensive. For example, let us suppose that the market will take only cedar and mahogany, and that the forest is situated far from the market in a mountainous country with no roads, railroads, or navigable streams; suppose also that the forest contains, in addition to cedar and mahogany, a number of other species of trees which yield good building material, good wood for making paper pulp and several other products for which there is at present no demand. Under these circumstances

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the lumberman can take only the cedar and mahogany because this is all he can sell; even though he could develop a market for some of the other products he could bring in only those for which a high price is obtained, because, with the high cost of transportation, only the more valuable products can be marketed at a profit. These conditions make it extremely difficult to sell the timber without impairing the forest. Good forestry requires that the mature trees of all kinds be taken and that the more valuable trees be left for seed in preference to the others so as to increase the value of the future forest. The tendency of these conditions is to make scientific work in forestry appear superfluous. What is the use of scientific research when even the simplest rudiments of forestry can not be put into practice? The answer is that these circumstances, far from rendering scientific research superfluous, make it doubly necessary. Research alone will discover safe and profitable ways out of the difficulty. Research in the forest will discover how best to manage the forest under any set of conditions, whether adverse or favorable. Research in forest products will discover uses for the trees and other materials which should be taken out of the forest, and research in economics will open outlets for the distribution of these materials.

## Adjournment.

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## SESSION OF SUBSECTION 4 OF SECTION III.

RALEIGH HOTEL,
*Wednesday morning, January 5, 1916.*

Chairman, SAMUEL FORTIER.

GENERAL TOPIC:

**Pan American Theme: "Governmental Participation in Irrigation Development."**

(It is understood that the word "governmental" includes the States, country, province, or other political subdivisions, and that the word "participation" might well include the construction, management, and settlement of irrigation enterprises.)

The session was called to order at 9.30 o'clock by the chairman.

The CHAIRMAN. The first paper on the program is, "State aid to irrigation and swamp-land reclamation projects," by C. E. Grunsky, San Francisco. It will be read by title only, as Mr. Grunsky was unable to attend the Congress.

### STATE AID TO IRRIGATION AND SWAMPLAND RECLAMATION PROJECTS.

By C. E. GRUNSKY,

*President American Engineering Corporation, San Francisco, Cal.*

Every community project which is undertaken for the increase of the agricultural area or for the increase of agricultural output should have sufficient merit to bear investigation. It should be economically sound. There should be provided by the the State adequate machinery to investigate and determine this question of economic soundness.

The need of thorough investigation and careful study is particularly apparent in the case of the flood-control problems such as are presented in various parts of the country. For the protection of Dayton, Ohio, the plan which has been adopted for the treatment of the Great Miami River involves the creation of detention reservoirs, for which seven sites have been selected.

Lands not naturally subject to inundation are to be occasionally flooded when the river reaches a danger stage, and by means of the temporary withholding of water from the river at the right moment, the flood volume in the lower sections of the stream is to be reduced.

The flood-control project for the Sacramento Valley, in California, involves as one of its essential features the elimination of large, natural flood basins and an increase of channel capacity supplemented by a system of by-passes. The



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principle adopted for this river in 1910 was reversed on the Great Miami a few years later. For each of these rivers the adopted solution is to be accepted as sound.

But the fact is made plain that where principles so diametrically opposed are to be properly applied, no execution of reclamation work should be sanctioned until approved by competent authority. Expert advice should be made available through an adequately organized permanent State department, and such a department can not be made effective without adequate financial provision.

There should be connected with such a department an engineering staff that can be held responsible not alone for a proper construction of works, but for a full presentation of the economic facts which render the works advisable.

A State department of this character should be placed in charge of all flood control, irrigation, swamp-land reclamation, and drainage projects which are to receive State aid. The State should go further than merely to study projects and pass upon their merits. It should lend its credit for the carrying out of the meritorious project. The cost in each case, except perhaps only that involved in the general study of each problem, should in the end fall upon the property owner who is benefited by the work.

The speaker's familiarity with conditions in California may justify a reference to that State in presenting the advantages that would result from such State aid as he believes would go far toward solving some of the difficulties which are largely the outgrowth of the world's lack of confidence in irrigation securities.

As the outgrowth of the work done by the first State engineer of California, whose investigations began in the spring of 1878, there was passed by the legislature of 1887 a law authorizing the formation of irrigation districts. This, in its original form, was known as the Wright law, after its author, C. C. Wright, of Modesto. In amended and greatly improved form it is still upon the statute books.

A number of irrigation districts, such as Turlock irrigation district and Modesto irrigation district, both of which take water from Tuolumne River; Alta irrigation district, on the south side of Kings River; and the more recent South San Joaquin and Oakdale districts, on the Stanislaus River, and others, are successfully operating under the provisions of the irrigation district law. Under the law in its original form districts embracing areas succeptible of irrigation by a common system of works were formed by the county supervisors upon petition of 50 landowners. This was done upon evidence furnished by the interested parties and such volunteer testimony as circumstances brought to the fore.

The adaptability of the land in the district to development by irrigation, the availability of the necessary water, and the economic aspects of each project could, under such circumstances, receive but scant consideration, and the result proved very unfortunate for California. The formation of districts was pushed vigorously, and it was not long before there were more than 30 in which more or less progress had been made toward the construction of works.

The law provided for management of the affairs of each district by a board of directors, whose members were elected from five divisions into which each district was divided.

When the board of directors, upon necessary investigation and survey by a staff of engineers, had determined upon a source of water and upon a plan of works and the cost thereof had been estimated the question of authorizing a bond issue was submitted to the voters. The bonds when voted could be sold to the highest bidder, but not at less than 90 per cent of par.

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Operations under this law made its weaknesses, some of which have since been corrected, quickly apparent. In many sparsely populated regions only inferior material was available for the board of directors. The complicated affairs of the districts were handled in many cases by men of neither business experience nor ability.

In some cases there was a wholesale transfer of small areas of land in order that there might be landowners enough to sign petitions for the formation of a district. In other cases districts were formed where the water supply was inadequate or where water titles were involved in such uncertainty that success could not be hoped for.

Under these circumstances, despite favorable legal opinion relating to the constitutionality of the irrigation-district law, confirmed ultimately by the courts, the bonds issued by the several districts could not be sold in the world's markets.

It was of no avail to tell the ultimate bond buyer of Europe that this particular bond was the bond of a successful district, which would not default in the payment of capital and interest. To him it looked no better than the other bond which had brought him a complete or partial loss. Even though he might believe the representations now made, how could he make his neighbors believe them when the time came for him to pass the bonds to a new holder?

Even some of the districts which are now in successful operation have had their financial troubles. Some of these when ready 25 years ago to build works found that the market would not take their bonds. The district bonds were therefore sold to a dummy at the minimum price allowed by law, and contracts were awarded for the construction of dams and irrigation canals with the understanding that the contractors would make provision for taking and placing the bonds, through the dummy as intermediary, as payments became due in the contract work.

The work done under these circumstances by the irrigation districts has been expensive. Much of the earlier work cost 50 to 75 per cent more than it would have cost if the districts had had cash in their treasuries. Even the districts organized in recent years have been compelled to pay an extra 20 to 30 per cent because of the difficulties of marketing their securities.

In these instances it is apparent that the works which are necessary for the proper development of large, fertile areas of great potentiality have cost more than they ought to have cost.

It should be noted, however, that the community project, such as the irrigation district, is not the only type of project which has had to pay a high price for the marketing of its securities. The discrediting of irrigation securities in the world's bond markets has applied as well to the private projects, and in many cases these, too, have had to carry heavy extra burdens due to a lack of confidence for which there was often no apparent foundation.

California attempted to prevent the excessive cost of marketing irrigation-district securities by prescribing at first a limit of 90 per cent, below which bonds could not be sold. Later this limit was made par, but as the law was easily circumvented all restriction relating to the price at which bonds may be sold has recently been removed. There is, however, now some State supervision of the irrigation district work, or rather the project is made subject to the approval of a State commission consisting of the State engineer, the attorney general, and the commissioner of banks. This commission has now been active for some years, and some hope is held out that under a close supervision by the State the condition will be improved. It is agreed that the supervision of the State would weed out the undesirable enterprise, and that the district bond, which carries on its face evidence of approval by the State authorities, should find a better place in the bond market than the older bonds.

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This may be the result when the effectiveness of State supervision and State approval has been demonstrated. But the demonstration will take time, and no speedy results commensurate with the need are likely to be realized. That too much should not be expected from such a supervision, no matter how carefully exercised, will be understood by those who know from experience that without State responsibility the supervision will not satisfy the investor in irrigation securites.

It has been seriously suggested that the State should guarantee the payment and interest of irrigation-district bonds. Such a guarantee may be feasible, but seems impracticable, particularly as in the case of such a guarantee similar guarantees will be demanded for other quasi-public bonds.

Nevertheless, the State is vitally interested in the success of all enterprises which are of benefit to and encourage the home builder. The State should be willing, therefore, to assume the direction of reclamation enterprises, whether the reclamation be by irrigation, drainage, or protection against floods.

The State, in the case of such projects as are here under consideration, may well undertake to supplement volunteer evidence as to feasibility with investigations of its own.

The State, when satisfied of the feasibility and economic value of such a project, should outline the district that will pay for the works. It should make the plans for the works and the cost estimate thereof. Thereupon the district which is to be taxed for the works should determine whether it will submit to the necessary tax.

When this has been favorably determined, the State should issue the necessary bonds, not as district but as State bonds, and these should go into the market without any conditions relating to the success or failure of the enterprise which gives rise to their issue.

The State should thereupon construct the works and turn them over to the district for management, except in so far as control of parts thereof might be thought essential for the protection of interests outside of the district.

Through the proper State officials taxes should be levied from year to year upon the property in the district, to meet interest on the bonds and to provide a sinking fund.

It will be found desirable to allow some years—possibly five—to pass without collecting any sinking-fund increment, and to let the retirement of the bonds progress thereafter at an increasing annual rate throughout a period of 40 to 50 years.

The plan of levying assessments for reclamation work in proportion to benefits has found favor in some portions of the country. Generally the lands which receive the greatest benefit from the improvement are originally the least valuable. There will be cases where the assessment for benefits will greatly exceed the present value of the land.

How, under such circumstances, can the owner meet the assessment which may have to be collected at once in order that funds may be available for construction? How can a substantial payment for works of future benefit be expected from the landowner when there will be no increased revenue possible until the whole project is complete? Warrants to be issued for the work will not overcome the difficulty. Some one would have to be found to take the warrants. No other course seems open except to rely upon State aid when such conditions are manifest. The State should finance the project; State bonds should be issued to meet its cost; the State should plan and execute the works and should assume responsibility for their adequacy. The State should there-

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upon levy the necessary taxes to cover interest and to retire bonds, thereby relieving the district of much overhead expense. The cost of the works would thus be collected from the owners of the lands in the district, including city and town lots, when the same are benefited thereby.

Through this arrangement the discrediting of the bonds will be avoided, the demand upon the landowner will be made light, his taxes will be bearable; bonds will be repaid when the land is productive and can stand the additional burden; and, above all, the early execution of large units of the project will be made possible.

Such a plan, while giving to a local district all the advantage of the State's credit, would not require any contribution from those parts of the State not within the district, except only to provide the machinery with which to make investigations and to start the work.

And, finally, each district in which work is done would pay reclamation or flood control or other taxes only to the extent that works for its own protection were necessary.

The direct benefit to the whole State in the shape of early increase of taxable values and the indirect benefit resulting from the development of resources now latent would be so great that there should be no hesitation in carrying out a plan as here outlined.

To carry out these suggestions, the legislature should be given authority by constitutional amendment, if necessary, to authorize the issuance of State bonds from time to time in such amounts as may be required for the construction of works and the acquisition of lands and other property, and machinery should be provided to tax the property benefited to meet the interest and sinking fund on the bonds issued from time to time. The bonds should be State bonds. The interest payments thereon and the amortization thereof should be assumed by the State and should in no way be predicated upon the success or failure of any project that may be undertaken.

For the successful carrying out of a program as here outlined, which places upon the State the responsibility for the success of the individual project, there should be created in each State a department of public works on a permanent basis with power—

(*a*) To outline and define the extent of "flood control," "reclamation," and "irrigation" districts.

(*b*) To plan works for the benefit of such districts.

(*c*) To determine the cost of such works and to apportion this cost to the districts or to subdivisions thereof in accordance with the benefits conferred.

(*d*) To submit to the property owners of each district thus formed the question of whether the works shall be carried out for the district as planned.

(*e*) To determine the order in which the work for the benefit of any district shall be carried out.

(*f*) To prepare specifications for the construction of district works, to let contracts for their construction or to undertake their construction by day's labor, and to supervise construction.

(*g*) To take permanent charge of the maintenance and operation of works which are by the board declared to be of general benefit, such as reservoirs, dams, and similar structures.

Special attention has been given in the foregoing to conditions which prevail in California, but California is not the only State which would profit by having a system of State aid as outlined. Other States have tried to give standing to the Carey Act and other irrigation enterprises by requiring them to have the approval of some State commission, but in every case without placing any

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responsibility on the State. Examination and approval under such circumstances is not convincing to the capitalist and to the bond broker and will not make the irrigation bond a liquid security. The time has come when the State must go a step further, and in doing so must assume a measure of responsibility. It can be done as above set forth without either committing the State to any materially higher taxation nor yet placing a burden upon the landowner which he does not welcome.

The CHAIRMAN. I might say, in a word, that Mr. Grunsky in his paper not only advocates State aid to irrigation and drainage, but also the creation of a State department similar to that of the public works department, in order to make a careful study of the problems connected with irrigation and drainage and also to construct and maintain them, if necessary. The next paper, "Irrigation and public policy in Peru," is by Mr. C. W. Sutton, civil engineer, New York, and recently in charge of the irrigation service of the Republic of Peru. I take pleasure in calling upon Mr. Sutton to read his paper.

## IRRIGATION AND PUBLIC POLICY IN PERU.

By C. W. SUTTON,

*Consulting Civil Engineer, New York City.*

Although there are many phases into which the irrigation problem of Peru can be analyzed, there is only one aspect of the subject which is of essential importance at this time. This is the question of the relation to public policy of the processes by which agriculture can be successfully established and improved upon the arid land of the coast.

The Peruvian Government has made an inventory of soils and water supplies that affect the extension of the coastal agriculture, and it has made estimates of the cost of new projects. These inventories and estimates were made in order that the synthetic processes of constructive politics and administration might be accompanied by a more nearly complete perspective in the field of natural resources.

There are other material facts and conditions aside from the ones already considered and susceptible also of measurement and estimation, which are required for the formulation of a correct policy. The entire subject will be briefly considered under the headings: (1) Physiography and climate; (2) Population; (3) Land exploitation and value; (4) Available projects; (5) The evolution of institutions and policies affecting the development of the arid lands; (6) The trend of present-day policies; and (7) Conclusions.

### PHYSIOGRAPHY AND CLIMATE.

Under this caption the physiography of Peru may be described as the physiography of the Cordillera, which rests its flanks upon both the eastern and western frontiers of the country throughout the central and southern parts thereof. The Andes generally maintain an altitude greater than 14,000 feet and drop from this elevation to sea level in an average distance of 80 miles on the Pacific side.

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The Atlantic trade winds blowing across the Brazilian Plateau precipitate their moisture upon the summit region of the Andes, leaving the Pacific slopes with a constantly diminishing rainfall as they drop toward the coastal plain. The coastal plain is a narrow strip of flat land 80 miles in width at its broadest part, disappearing completely in places, having a total length of 1,400 miles in the Peruvian territory. It enjoys less than 4 inches of rain per year excepting a small area in the extreme north.

For purposes of general description the national domain may be considered in three phases—that is, the highlands along the broad plateau-like summit of the Cordillera; the coastal region, including the coastal plain and merging into the Sierra at the base of the highlands; and the Montaña or humid forested slopes of the Brazilian side.

Attention should be called to the extremely steep gradients imposed by the relation of the highlands to the coast. All the watersheds of the Pacific slope are small, the largest being 6,100 square miles in effective catchment area. The size of watershed occurring with greatest frequency is that between 400 and 800 square miles of effective catchment area. The discharges per square mile of effective catchment vary from 100 acre-feet per year on the small intermittent streams to as much as 500 acre-feet per year on the larger perennial streams. Although the size of watershed does not alone determine the continuity of flow, as a general rule streams of less than 1,000 square miles in effective catchment area are intermittent. Watersheds of this type are those which occur with greatest frequency, and in all of the 55 independent river systems on the Pacific coast approximately one-half of the total annual run-off occurs from January to March or April. This period embraces the summer of the Southern Hemisphere, and although the demarcation of seasons is scarcely perceptible, the favorable seasons for planting most crops, and especially the staple crop, cotton, is from August to the middle of November, when the streams are at their stage of minimum flow.

## POPULATION.

The meagerness of statistics makes any analysis of the conditions and occurrence of population more or less conjectural. The population at the beginning of the nineteenth century was approximately 1,100,000 inhabitants. In 1876 it had increased to 2,700,000 inhabitants. No census has been taken since 1876. Dr. Luis Pesce in a study published in 1906 estimates the population in 1896 to have been 3,800,000. Dr. Alejandro Garland in 1906 stated it to have been 3,600,000 in that year and included 450,000 savages of the Amazon Basin in his estimate. Dr. Joaquin Capelo, in a review of statistics published in 1911, estimated the population at that time to have been 3,312,562, not including savage tribes of the interior. If the rate of increase that gave rise to the difference between the enumerations of 1862 and 1876 is assumed to apply to the period from 1876 to the present, the population to-day is 3,437,000.

The greater part of the population has seemingly always dwelt in the highlands or near them. The highland races conquered the coastal people in precolonial times. The coastal types of to-day in the rural districts may be considered a mixture of the original coastal stock with the native highland races and with various European races, principally those from the Iberian Peninsula. Whatever doubt may be entertained about the adaptability of the highland types to agricultural life on the coast, the present-day coastal types are unquestionably adapted to such life. Both highland and lowland stocks are agricultural in habit and very strongly attached to the land and to farming pursuits. Considering the population as distributed according to the three

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general physical divisions referred to, the inhabitants in 1876 were distributed as follows: There were 1,503,548 people in the highlands above the general altitude of 7,000 or 8,000 feet; on the coast and along the confined valleys between the coastal plain and the highlands there were 568,620 people; and in the Amazon Basin along the upper tributaries of that river, and upon the Amazon slopes of the Cordillera there were 554,756 people. Considering the coastal region only as capable of furnishing population for the arid coastal regions, its population to-day is probably not less than 740,000, of which probably 100,000 are males between the ages of 20 and 40. It is presumably this number, increasing at the rate of approximately 6 per 1,000 and per year or more, from which new agricultural elements of the coastal population must be recruited, unless suitable foreign immigration can be obtained.

The population we have referred to in the coastal region is distributed over a total area of approximately 75,000 square miles; that is, according to a density of 10 per square mile. When we take out for the great tracts of waste land and consider only that land which is actually settled and habitable under present conditions and to a large extent under any conditions which may, by any means, be brought about, the effective density is very great. In some of the valleys the density is as great as 300 persons per square mile. The total urban population of Peru—that is, the population occupying towns of more than 10,000 inhabitants—is not in excess of 500,000 people to-day. The average density of the irrigated portions of the coastal plain—that is, upon the habitable portion of the country—is probably more than 100 per square mile. It should be said, with all frankness, that these figures that I am giving are very far indeed from figures having the weight of statistics. They are only remotely derived from statistics, but in the absence of census enumerations giving such figures, it has been necessary to make an estimate, and this estimate has been carefully considered in the light of all the evidence available. Even if these estimates are widely amiss, and even if the population has remained absolutely in a static condition since 1895, it is evident that the public problems of Peru are as much concerned with how to adequately take care of the actual coastal population as they are with the introduction of large numbers of foreign immigrants; for if population is not increasing at the rate assumed since the last official census, it has failed to do so not because the Peruvian man is a sterile animal, but because of the influence of economic and sanitary conditions upon the birth rate and mortality; and, for the purposes of our discussion, this latter premise leads to the same conclusion we later establish.

The total foreign population of Peru in 1901 was estimated at less than 50,000, of which 30,000 were Asiatics and 10,000 Italian. Most of this foreign population was engaged in mercantile pursuits. Peru is not yet in the current of the western migration of European peoples, and there are many obstacles to be overcome within the country before any important current of immigration can be established.

### LAND, ITS EXPLOITATION AND VALUE.

Although Peru was a plantation colony of Spain, and although it has preserved many features characteristic of such plantation, as distinguished from farming communities, there have always been on the coast and in the Sierra a considerable element of small farmers owning their own land or occupying communal allotments. This element of the population should be distinguished from the peon landless class. The minute subdivision of these small holdings which has taken place from generation to generation tends to make the average

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size of farms much smaller than one would at first predict in view of the great size of many of the estates.

The important facts of the land situation on the coast are that the irrigated lands have reached their limit in the existing order of things, and many of the small farms are so minute that they can not be subdivided any further. The sons of the small farmer therefore are now, or soon will be, obliged to seek employment in the few larger urban centers, work on the large estates as peons, work in the mines, or become tenants under the share system where their relative lack of skill in agriculture and the processes of bargaining place them at a disadvantage.

While good lands with sufficient water, organized in large units are valued at from $50 to $140 per acre, quite a different condition exists among the communities of small holdings. It is seldom that these small holdings can be bought at less than $150 per acre when offered in units of less than 10 or 15 acres, and the price frequently rises to $700 per acre. The whole subject of land values on the coast of Peru will be better understood when it is stated that along the entire 1,400 miles of coast and in the 55 valleys crossing the coastal plain there are only 1,000 square miles of irrigated land. Both holders of large and small estates have long been accustomed to the rigid limitations placed upon the supply of land by physical conditions, economic organization, and public policy. The small farmer does not therefore think of looking afar for new holdings, and the large estate owner or manager can count on his fingers the large estates which can probably be bought at any time. Any additions to demand quickly, therefore, cause a noticeable rise in price. Wherever competition within the last few years has been at all noticeable—that is, where there have been even two buyers and one seller—the price of land with water right has risen to the neighborhood of $140 per acre, when the lands were offered in large units, the purchasers aiming at exploitation in the plantation form with peon labor.

The subdivision of large estates into small holdings for sale has not under these conditions been attempted, nor is it likely to occur. This would be a new type of enterprise, requiring conditions which do not exist at present. The ownership of land carries with it certain political and social privileges which give to it a value not derivable from its ability to produce economic rent.

For a number of years, therefore, there have been evidences that the population of Peru on the coast was feeling the pressure of a scarcity of economic opportunity, and the Government has been constrained to consider the possible utilization of the arid lands lying outside the present irrigated districts.

### AVAILABLE PROJECTS.

Up until 10 years ago it was believed that great areas of the coastal plain between valley and valley could be converted into farms as productive as those immediately adjoining the rivers. Within the last 10 years it was stated that 50,000,000 acres of land were available for irrigation. Investigation has reduced this estimate to 1,000,000 acres of lands lying in convenient relation to water supply and under the conditions of production and marketing imposed.

Under the Inca régime there were, according to the old chroniclers, from 10,000,000 to 12,000,000 people within the territory now comprising Peru. Whether this is true or not, population was evidently large enough to consume all of the few varieties of crops grown, and the staple crops under these conditions were such that they could be produced upon the coast during the

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flood season. Therefore, the problem of stream regulation did not have the importance it has under conditions where perennial crops are grown or where crops requiring irrigation in August and September are made more profitable by the existence of an export market. With a larger population and with higher standards of consumption in Peru, a great deal of land upon intermittent streams colud be profitably utilized in the production of quick-growing summer crops. But if the supply of these quick-growing crops to-day passes a certain limit the price falls quickly to a point where profits are much less than those obtainable from the staple export crops, commanding a world market.

Assumptions regarding the exploitation and value of lands upon the coast to be reclaimed by irrigation, therefore, start from these conditions—namely, an export market for crops requiring irrigation in the season when the stream discharge is at a minimum, and a generally low standard of production and consumption among the masses of the population. Calculations of the probable value of the products of new bodies of irrigated lands are therefore generally based upon the growth of cotton, the average production of which for all grades and sizes of land is approximately one bale of ginned fiber to the acre. Sugar is also a profitable crop, but difficult to establish as a means of agrarian reform.

Of approximately 1,000,000 acres available for irrigation under the conditions described, 126,500 acres may be considered as uniting all of the properties required to make them immediately irrigable. The lowest cost per acre on these projects is estimated at $19, this unusually low estimate being due to the fact that an old Inca canal can be utilized. The most costly project of this series is estimated to require a disbursement of $105 per acre for engineering works alone, exclusive of bond discount, interest, etc. In addition to these most favorably situated projects there are four other projects aggregating 242,000 acres, and estimated to cost $20,650,000. The average estimated cost of the first series is $55 per acre, and of the second $85 per acre. In the first series no storage works or long diversions are necessary. In the second series some relatively small storage works and some rather long diversions are called for. The remaining 630,000 acres include lands either of more unfavorable conditions of soil or subsoil or lands requiring long diversions or more costly storage works, and have been considered as near the margin of reclaimable lands under present economic conditions.

## THE EVOLUTION OF INSTITUTIONS AND POLICIES AFFECTING THE DEVELOPMENT OF THE ARID LANDS.

In 1824, at the beginning of the republican era, Peru faced a problem much more difficult in every way than that which had confronted the Government of Washington in 1789. In 1830 the population of the United States was 12,866,000, of which 10,526,248 were classified as whites; that is, 82 per cent of the population was presumably capable of participating in or of contributing to the class which did take part in the determination of public policies through the representation of the economic interests of the various localities and types of population. In Peru in 1836 the population was 1,374,000, of which not more than 180,000 were classified as whites, the rest being classified by the census takers as Indian, mixed, negro slaves, free negroes, and mulattoes. Classifications of this kind can not be understood to have any particularly accurate ethnical significance, but in this case they should be taken as having a determined political significance. Not alone from choice but as a whole from necessity, Peru began her career as an independent nation with more than 80 per cent of the population regarded by the governing class, and probably justly so,

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as without capacity for self-government, whatever may have been the provisions of the written constitution.

Furthermore, in 1830, there were in the United States 3,000 miles of railways and navigable waterways. In 1915, nearly 100 years later, there were in Peru less than 2,000 miles of railways and no navigation canals. The United States was in the track of migration of European peoples, and possessed immense areas of fertile lands, forests, and mines. The thought may be justly entertained that the progress and prosperity which the United States has enjoyed has been largely due to the exceptional combination of these circumstances. Peru, upon the other hand, was quite out of the track of migration from the older countries, and whatever resources they might then have had, or now have, occurred under physical difficulties which do not make them easy of exploitation.

The United States did not, however, apparently, adopt such beneficial policies as the homestead policy spontaneously, nor because of any instinctive wisdom, foresight, or democratic sentiment. The homestead act was debated in Congress for nearly 30 years and was given a place upon the statute books of the Nation in 1862. The history of the homestead act is a history of the struggle for the balance of economic advantage between different sections of the United States.

For many years after the establishment of the Republican régime in Peru, public policy was dominated by the theory that capital was the only element needed to produce a prosperous national community out of the distinctly different classes of the population upon the physical basis determined by the physiography of the Cordillera. This theory, it should be noticed, has been common to all new countries. It has produced beneficial results, when other things were equal—that is, when the governing class has been relatively homogeneous in political capacity and in the consciousness of political power, and where consequently it has been difficult for any one element to maintain the balance of power without making compromises and concessions that have checked the tendency toward class government. Capital will always be necessary for the development of raw resources, and in new countries it must be foreign capital, but the success of investments of capital depends in the long run upon the standards of production and consumption of the population in the country where investments are made.

Peru enjoyed some exceptional conditions in the character of its sources of wealth. The Government possessed valuable guano deposits, and, later, nitrate deposits. It once mortgaged the first for its public debt, and later granted the right of exploitation of the guano and the right to operate the national railways in return for the assumption of this debt by a foreign corporation. The nitrate deposits were lost in the war with Chile. Peru then found herself relatively free from debt as she has remained up to the present time, but the Government's sources of revenue have been seriously curtailed.

In 1895 an irrigation law was passed in which the old test of public policy was stated in terms applicable to the development of the arid lands. The preamble of this law stated that it was convenient for the Government to obtain the growth of more crops in the arid region by any means in its power, and went on to provide that the public lands could be granted in any quantity whatever under any system of exploitation so long as these crops were promised. Under this law, and the policy of which it was a partial expression, nearly all the public lands of that period passed into the hands of concessionaires who have held the lands without developing them, although the

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ministerial regulations provided that the concessions should lapse after a period when the lands were not effectively developed.

Nothing having been accomplished under this law, in 1913, following the formulation of the inventories and estimates regarding the irrigable lands on the coast, a new law was promulgated providing for the issue of bonds of the par value of £2,000,000, the proceeds of which were to be applied to irrigation and colonization of selected projects. In this law, however, it was also provided that the Government could guarantee the interest up to 5½ per cent on private capital invested in irrigation works, and the method of tenure and exploitation left open. Those charged, therefore, with the administration of this law were obliged to concentrate their attention upon the question of what was a proper test of public policy where the law left open two divergent methods of procedure. Upon the one hand, the law told the administrator that the aim of policy was the settlement of the State lands in small holdings, and the inference was that it had been the intention to define the test of policy as the degree in which it favored the improvement of the types of population, and the assimilation of the best types into the national community. On the other hand, the law consented that the investment of capital was in itself an aim and sufficient test of policy, and that the results following such investment could be left to take care of themselves, the Government guaranteeing dividends on shares and interest on bonds whether the business of land exploitation was profitably managed or not, or whether the plantation or homestead system was followed.

Under the clause providing for a guaranty of private capital invested in irrigation works a petition was made for bodies of land which in the aggregate would have included all of the projects available according to the criterion of land values already referred to in this paper. If this petition had been granted there would have been relatively little land left for the application of a land-settlement policy by the Government, even if the national credit, after burdening itself with the stipulated guaranty to the concessionaires, could have carried the debt necessary for the construction and colonization of projects left over after the concessionaire had had his selection. It was, therefore, concluded inadvisable to make use of the plantation system allowed under the concession clause of the law, and, if possible, to employ the Government's credit exclusively for the furthering of the land settlement in small holdings.

This law has not produced any effect as yet unless it be an effect upon public opinion as to the proper test of public policy. One of the chief reasons for this has been that the Government insists upon throwing upon the capitalist the risks of colonization. No one can answer the question whether European immigrants could be induced to take up the irrigated lands in small lots and repay the Government for its disbursements. Neither can the capitalist assume that land settlement can be accomplished by recruiting the settlers from among the coastal population itself.

Under these circumstances it is not only a question of what should be the test of public policy, it is also one of what policy can be successfully established. It is probable that the line of least resistance at first and the type of policy giving the most immediate results of a certain economic type would be that which permitted the exploitation of the present waste lands in large estates formed by the construction of irrigation works with the Government's credit, such estates to be exploited under the peon system. It is a question, however, even in this case whether such a labor system as this implies would be a satisfactory one to the estate managers themselves. It is now necessary to recruit peon labor for the coastal estates by means of a system somewhat akin to forced impressments of the Indian population of the highlands.

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Upon the other hand, although the small farmer of the coast pays more for rent than he would be required to pay under a Government reclamation policy designed to foment the small holding system, the small farmer is not to be considered a high-grade farmer. Irrigated land is not marginal land in the sense that this term has been employed by economists. It is never no-rent land and must always produce the interest upon a relatively large sum of money. Irrigated land at present must generally be in the first categories of high-grade arable land, and the low-grade farmer can not have a place in the successful irrigated community. Although the average production of cotton for Peru is approximately one bale to the acre, the small farmer often obtains only one-half a bale, while the large estates generally produce two bales to the acre.

When we consider the question of immigration things do not look much brighter. It is true that in Europe the stress of population upon marginal lands and resources has produced an overflow of population into more sparsely settled countries, but the European immigrant prefers communities where a certain momentum in the immigrant movement has already been established. Even in those South American countries where immigration is already important, a positive increase in the permanent population has been of slow growth. The first immigrants return to the old country the wealth they acquire in the new. Furthermore, the greater part of the immigrant population established in the United States during the last 20 years, although having come from rural communities in Europe, has settled about the industrial centers of the cities and taken part in the growth of the manufacturing industry rather than in that of agriculture. It is a question whether such settlers as could be obtained from Europe to-day, always supposing conditions which existed before the present European war, could be any more quickly adapted to the requirements of a reclamation settlement policy of the coastal lands than the growing coastal population itself.

But in the question of public policies another consideration arises. Such policies in all countries manifest themselves as results of the struggle for the balance of economic and political power between the elements of population in a country. It is therefore pertinent to ask if the interest of the older element of the governing class in Peru would be best conserved by granting the State lands as plantations to be worked by foreign companies in which private interests among the governing class had a certain representation; or would it be best conserved by settling the arid lands with small farmers that could constitute among the governing elements of the future, a third element serving to preserve the balance of power at a point convenient for the best interests of the governing elements of to-day, and as they are also to be modified under the future influence of economic life.

### THE TREND OF PRESENT-DAY POLICIES.

Some of the governing class believe that Peru can not, others that it should not, be anything but a Plantation State. Both of these beliefs are supported by the quality of available material.

Both the law of 1913 and the Government's interpretation of it up to this time, however, may be taken to indicate that those holding the balance of political power to-day believe it to their best interests to establish the small land-holding system, if possible, upon lands to be reclaimed. The chief probability of the abandonment of such an interpretation of the law arises out of the difficulties believed to attend colonization.

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Companies have been found who are willing to underwrite the bonds, build the works, and colonize the lands, but they regard the risk of colonization so high that the total charges would run the annual payments to be made by settlers up to an average of $12.50 per acre on the most favorable projects when the amortization period is 20 years.

Not the least of the Government's difficulties in this connection is the problem of finding established firms to engage in enterprises combining so many and diverse activities. It is not a question of simply taking bonds upon the Government's guaranty, nor of building irrigation works at a stipulated price, nor of stimulating an immigrant current. All of these processes must be combined, and the combination must be made in such a way that there is active cooperation and simultaneous interest in all the processes. If contracts of this character are let they must be so designed as to automatically provide for the carrying out of each step from the time the bonds are issued to the time the lands are settled. The company undertaking such an enterprise could not afford to collect payments from the colonists. It must depend upon the Government's credit for its remuneration and place upon the Government the burden of collecting revenue. Considering all of the phases of the situation, it seems difficult to escape the conviction that the Government must make itself responsible for the land settlement and the effectiveness of revenue production which that implies. This has not been, however, the tendency of theories of policy.

## CONCLUSIONS.

In summing up the situation two clearly related but analytically separable propositions seem to stand out as the essential premises of political action in this matter. The order in which these propositions is stated is indifferent; one is as important as the other; each is reciprocal to the other. The first is that an active campaign of agricultural education is absolutely necessary whether settlers be recruited from native or foreign populations. The second is that the Government's fiscal administration and public credit must be placed in a condition which can not be impeached by those who in the defense of their own interest must critically analyze the elements of risk in the loaning of funds, or by those who may consider it to their present interest to prevent the development of social policies.

The acceptance of the first of these propositions means that in addition to the school of agriculture situated in Lima, and available to only the sons of those whose economic opportunities are already fairly well secured, there must be established at various points along the coast, centers of agricultural experiment and demonstration aimed to reach, at any cost, the small farmer, be he native or immigrant. The standards of production and consumption must be raised in this way and further stimulated by the inculcation of cooperative habits in various ways. The acceptance of the second proposition means among other things a reform in the system of taxation designed to appropriate the Government's share of the social income in a more equable scale.

Both of these propositions, and the lines of action that their acceptance implies, open to the view problems more difficult than any yet systematically studied by those interested in the public welfare of Peru. The classes of problems are only secondarily of the categories of civil or hydraulic engineering, which have already been systematically studied to an extent largely sufficient for the purpose of guiding public policies. No matter what may be the particular point of view of any one who looks at the reclaimable lands of the coast of Peru, the belief seems tenable that the foreign enterpriser and banker,

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the classes holding the balance of political power in Peru to-day, and the great mass of population taking little interest in public affairs and possessing none of the qualities which are likely to produce economic improvement under the old policies—all will be benefitted by the acceptance of these two propositions allied to a policy which aims at the employment of the arid lands of the coast for the extension of the small holding system.

The value of public utilities of all kinds, the opportunities for enterprise and the extension of trade and commerce, all depend upon the raising of the standards of production and consumption of the population, and the history of the trial and error process in the policies of Peru emphasizes this truism. It is not therefore so much a reclamation policy, nor a series of laws for reclamation purposes, nor the formation of a large series of public works, which Peru immediately requires. It is rather the establishment of a conservative administration with a carefully determined system of taxation accompained by an active department of agriculture with practical demonstration farms among the agricultural classes of relatively inferior knowledge of the modern art of farming on irrigated lands.

Inasmuch as the entire coastal population is used to irrigated farming and knows no other kind, the problem in this respect may not be so difficult as it has been in some parts of the United States. The authorized bond issue could be employed in the building of the more feasible projects, not all at once, but successively one after the other as the success of one and the other is established. The Government has ample imformation to enable it to select and build these projects to advantage, but it should first recognize the fact that it is the type of man upon the land that determines the success of irrigation, and first by a careful census of its own available resources in population, and then by the establishment of a practical system of education in agricultural technique and cooperation, seek to eliminate the errors of policy that would be ruinous to a country of so few available resources.

In developing an efficient type of farmer, a gradual process seems to be required. A natural evolution seems to be through the various stages of tenantry to ownership. Any of the objections which might upon theoretical or practical grounds be advanced against the interposition of such a series of graduated steps in the process of creating a convenient type of land holding, would seem to be susceptible of elimination by the use of a properly coordinated system of education combined with fiscal responsibility for the irrigation works. It may be that a scheme can be devised whereby the reclaimed land can be rented to the farmer until he has solved his first and most difficult problems of adjustment. The carrying out of such a plan depends primarily upon the acceptability of long term bonds, and this would, in turn, depend upon the stability of public revenues and national credit.

Upon the whole, it appears that policies have followed in Peru the same evolution that has characterized them in other nations of strong individualistic traditions and beliefs. In Peru, as in other countries of such traditions, policies have not at first embodied a full recognition of the fact that investments and production, although the bases of prosperity, are more effectively considered as means than as ends. After awhile there is thrown into stronger relief the fact that the success of investments and of fiscal activities depends upon the quality of population and that public policies must embody some recognition of this fact in both aim and method. The type of man upon the land then becomes the ultimate test of agricultural policy. The arrival at this stage in the evolution of policies brings with it advantages both from within and without the body

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politic, and there are indications in the countries where this stage is beginning to appear that it carries with it after a while a more or less spontaneous cooperation among many elements where conflicts formerly prevailed. Peru has long sought progress through the intervention of outside elements. These are still very necessary, but can be of no lasting avail without an effort by the Government designed to raise the standards of production and consumption among the population now available as a national asset. Immigration may play a part in this process; the process itself should not be delayed because immigration is not effective to-day.

It is true that Peru has large areas of undeveloped land lying on the Brazilian slopes of the cordillera. These lands, however, are not well known; there are no means of communication in that region. The cost of building railroads across the Andes is prohibitive unless for the purpose of developing raw materials of very high value and occurring in very large quantities.

Peru has endeavored for years to finance railroads into this country and is slowly progressing to that end, but the question of how to develop it and the question of whether the coastal population would readily adapt itself to the conditions there are questions more problematical than any concerned with the extension of irrigation on the coastal lands. Certainly it is not probable that European immigration could be directed to this region behind the Andes, even if railroads were built, until the pressure of population upon less remote countries is much more severe than it is to-day.

Immigration may be conveniently used for the purpose of placing sufficient pressure upon the coastal population and for the purpose of improving its standards, but I do not believe it should be used as a means of displacing or in any way that may displace the native's small farm. The existing coastal population is in itself a resource capable of development in quality. Theories of conservation of natural resources that ignore the value of the existing population, its capabilities of improvement, and its intrinsic quality of being an established home-loving element are incomplete and defeat the ends implied in conservation. In Peru conditions are such that the movement for the improvement of the standards of production and consumption must come from the upper stratum of society—from among the elements of the governing class. The differences in quality between the classes of population preclude the possibility of anything but a slow and painful evolution through the processes of struggle for the balance of economic opportunity.

The CHAIRMAN. My knowledge of conditions in Peru is so limited that, while this paper was being read, a number of questions arose in my mind, and I wished for further information. The same thing may have occurred to you. In the limited time we have there is an opportunity to ask a few questions, and you will no doubt take advantage of this chance for further information concerning this interesting topic.

A VOICE. I would like to ask about that serial bond that you speak of. What is the nature of the serial-bond issue, and what other bonds are issued?

Mr. SUTTON. The serial bond is simply a bond which is retired in parts each year. You issue $20,000,000 worth of bonds. The period of amortization is 20 years, and $1,000,000 is retired the first

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year, and so on each succeeding year. That means also that the rate of amortization can not be disturbed; it is uniform. There is more interest to pay the first year than there is in any other year, while the rate of amortization is constant. The interest is greater the first year, unless sinking funds are provided to regulate that rate, but they have not been considered.

The CHAIRMAN. What kind of bond would you suggest, Mr. Sutton?

Mr. SUTTON. I would suggest that the Peruvian Government issue long-term bonds—if necessary even 50-year bonds for its first projects—and that it allow the settler to simply rent the land. The fixed charges on those bonds should not deviate. Supposing they were to be all amortized in 20 years, that the interest rate was 5½ per cent, and that of the estimated average cost of projects about $8 per year would be assignable to interest and $8 to amortization. Now, for the first five or six years the colonist could be allowed to pay simply that interest as earned and at the end of the five-year period begin to pay his amortization, and the Government could maintain a sinking fund to take care of the amortization; if necessary, paying that out of the general revenues of the State or utilizing the increased revenues from the district where the regulation was practiced. Where these settlers went there would be an increase of imports, at any rate. The greatest revenue of Peru to-day is derived from its import taxes. Allow the settlers to benefit from the increase in revenue due to their settlement of the land, taking care of a part of the amortization, and at the end of this five-year period their amortization rate would have been reduced by a part of the debt and leave a fund derived from increased revenues which would have been produced. There we have a stage of tenancy, preceding that of ownership, by which the ownership was acquired, and recognition of the social value given by the land to the community or the settlement.

A VOICE. Would you still continue taxing the product rather than the land?

Mr. SUTTON. That is a question I would not change for the present. I would exempt all taxation on a product below a certain amount, as is done to-day in other countries. The fact is that the present taxation of the products in Peru is not an effective tax. And only after the land is more than strong enough to bear the burden of taxation would I place additional burden on the land. The object of the whole policy would be to do everything for the settler the first year. And inasmuch as I think it is not good psychology to give a man something for nothing, I believe it better to make the people who settle the land buy the land, but not to oblige them to crowd themselves too hard to pay the debt.



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The CHAIRMAN. Could you tell us, Mr. Sutton, the average cost of preparing land for irrigation in the country you have discussed?

Mr. SUTTON. I can not give you those figures from memory, but I should say that it certainly did not exceed, on the average, $15 per acre. Do you mean to include in that sum the leveling of the land, and perhaps the construction of farm laterals from the irrigation laterals?

The CHAIRMAN. Yes, it would include the main with ditches, as well as the distributaries around each farm, together with the irrigation structures and the leveling and grading of the land.

Mr. SUTTON. Ditches, together with lateral trenches, are usually constructed by the community. While the estimates that have been made there for the irrigation include the construction of the main canal and all of its accessories—the intake weir and reservoirs where necessary—all the secondaries are taken out of the main canal to distribute to the districts. In fact, the water is taken up to the farm lateral of the individual holder. The preparation of that individual holding simply consists in running very light and shallow ditches and leveling the land and clearing it from brush. It would not amount to $15 an acre. We have no hummocky land, as is sometimes the case in this country in the West.

A VOICE. You are familiar with the methods followed in this country. Do those of western Peru conform to our flooding border and furrow methods?

Mr. SUTTON. They have in Peru both of those methods. It is interesting to see how they have taken in knowledge from outside. The Indian population of Peru long before the whites came had worked out a very good system of inundation. The river where this is most pronounced is one which is somewhat similar in its flow to the Sacramento River; that is, the whole discharge comes down within three or four months and they have the stream practically dried up most of the time. They have to take that water as soon as it comes and distribute it over the land, and the land will soak it up. In order to do that they have built very large canals. I think the capacity of those canals in some cases was seven times the irrigating rate for this country. Theoretically, there are so many second-feet per acre, but they have seven times that because they have to concentrate in this short period. Then they built 1-meter deep squares and filled them 40 to 50 centimeters in depth. They were never flooded more than three times.

A VOICE. What would be the area of these squares?

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Mr. SUTTON. I should say not any larger than this room, and sometimes not more than half that. Then the soil of that part of Peru is a very fine sand, and that retains the moisture for months after this flooding has occurred.

The CHAIRMAN. Do you use the Batson method both for the forage crops and other crops?

Mr. SUTTON. Yes, the same system is used. Besides that they have the furrow system. They have the system of general flooding only on certain lands. Sometimes they just bring a lateral to the head and let it run over the field. That is very bad for the land, as it takes out all the good quality of the soil.

The CHAIRMAN. From what you state, Mr. Sutton, I would infer that the duty on water in that country would vary within a very wide limit. When water was plentiful in the streams large amounts would be used?

Mr. SUTTON. Yes.

The CHAIRMAN. Small amounts if the stream flow was low?

Mr. SUTTON. Exactly. In the summer season when the flow is plentiful the duty is as much as 1 second-foot for 30 acres; in the dry season 1 second-foot for 400 acres.

A VOICE. I would like to ask Mr. Sutton if there is any difficulty in disposing of the bonds that are issued, or, if none have been issued, would there be if an issue were made? In other words, is there a market for the bonds?

Mr. SUTTON. That is a very pertinent question, and I would like to get out of answering it if I could. Those bonds can be placed, but there is this difficult element: The carrying out of the accommodation scheme seems to require that you want to have the matter arranged in such a way that the moment the bonds are issued you start a process which will give you possession of the land also with the proceeds of that soil. The company that takes those bonds has them in such a way that they can not, in their own interest, abandon any step in the process themselves or do anything to hinder or abridge their interest. The final responsibility for the collection of revenue and the payment of interest and amortization of the bonds being charged against the Government, the Government is responsible. The element in that is that Peruvian bonds can not be sold upon the market at the same price as American bonds can be placed, or Argentine bonds. They must be sold at 90 or less. Furthermore, as the risks of amortization are great, nobody has ever attempted it. There have never been any successful schemes of colonization in South America anywhere. These companies must make a profit on colonization to cover a large risk; that is to say, they are charging as high as £18 per hectare for colonization on land in lots of 16

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hectares. The company gets, in some cases, $5,000 for bringing one man to Peru.

A VOICE. It seems to me that your statement would indicate the reason for having trouble in placing these bonds.

Mr. SUTTON. They are having trouble when you consider there is not a ready market for a Government bond of that kind. It seems to me that a definite policy might be adopted in Peru where colonization might be carried out in a simple way. For instance, this could be accomplished by first taxing the land, not the products, and using any rate that may be determined. You then have a secured value upon each bond issue. You do not have to depend upon the national wealth which may be fluctuating. Capital is invited to make an investment upon secured value which has been established. Then, going further than that, I think the national reclamation policy should be adopted in relation to this other policy so that one grants to the colonizer, the owner of the land, the interest on all of these irrigation works they establish during a period of 10, 20, or 30 years. Let the Government pay the interest out of the taxation derived from the land. Let the amortization charge be distributed about as it is with reclamation projects—say, for five years no charge whatsoever; after the fifth year make it $2.50, and increase until the land is productive; in the final year of the retiring of the bonds the heaviest obstacle would be removed. Then, in addition to that policy, I think they should adopt the Australian policy of not only providing the land free from any payment except that of taxation, but then finance the fund for the settler. That is one of the things he needs more than anything else. He may have sufficient means to come into the land, to develop it, and put it into shape, but he has not the means to pay for financing it. Therefore, I think special banks should be established whereby each individual could be allowed a certain amount toward the financing of himself in the development. If a very comprehensive policy of that kind were adopted, not only in the South American Republics, but also in Mexico, it would be of great help in solving the problem.

I would like to say that the question of changing the system there for relieving the man from interest payments amounts to the same thing because the amortization and interest charges would amount to the same thing. There is no question about whether the land should be taxed, but the question is how many people would be frightened at the start by instituting a system of this kind.

The CHAIRMAN. The next speaker on the program is Mr. R. P. Teele, United States Office of Public Roads and Rural Engineering, who will address us on the subject of "Public control of irrigation in the United States." I have pleasure in calling upon Mr. Teele.

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# PUBLIC CONTROL OF IRRIGATION IN THE UNITED STATES.

By R. P. TEELE,

*Irregation Economist, Office of Public Roads and Rural Engineering, United States Department of Agriculture.*

The necessity for public control of irrigation arises from two facts: (1) The supply of water is limited and its control constitutes a natural monopoly, which should not be in private hands; (2) it is impossible for the individual to protect his rights, since the stream which supplies them may flow for hundreds of miles through lands over which he has no control. Under these conditions lack of public control could result only in anarchy, except in sparsely settled regions where the supply of water exceeds the demand.

In this paper I shall attempt a statement of the facts regarding the control exercised by all Governmental agencies in the United States over the use of water for irrigation, rather than a discussion of the advantages or disadvantages of existing or proposed systems. Although the paper is based largely on the laws under which this control is exercised it is not a legal treatise, but a statement of what is done under the laws discussed.

In the United States, speaking generally, the degree of public control has increased directly with the scarcity of water. When our Federal Constitution was adopted settlement was limited to humid regions and, naturally, that document contains no provisions relating to irrigation. Similarly, so long as population was confined principally to our humid States, the Federal Congress passed no act relating to this subject. When settlement of our arid lands began that part of the country was largely without either nominal or actual civil government. Pioneers found a necessity for diverting water from streams, but no law governing such action. Under these conditions they made for themselves rules which should control those matters, and when courts were established they recognized and enforced these rules. The first Federal legislation relating to irrigation was the recognition, in 1866, of these "local customs, regulations and decisions." By this law of 1866 the Federal Government has been held to have surrendered any control it might have had over streams in the arid region by reason of its ownership of practically all of the lands of that region.

Since the passage of this law the Supreme Court has held repeatedly that the control of diversions from the nonnavigable streams of our arid region is vested in the several States, and all our laws on this subject are State laws.

In the passage of laws for control of irrigation the States have acted on two theories: One that the streams are the property of the States and that the States control them as proprietors; the other that the streams are public property and that the States control them under their police powers. The latter is the more commonly accepted theory. This difference in theory has not, however, made much difference in either the degree or the character of control exercised by the States.

As previously pointed out, public control of irrigation in the United States began with the regulations adopted by the pioneers and upheld by the courts. The next step in many States was the granting of control of diversions to the counties, and in some States legal development has gone no further. In most States, however, control has been assumed by the State itself. This control is outlined in the following paragraphs.

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NATURE AND EXTENT OF PUBLIC CONTROL.

The control of irrigation exercised by the States has covered the following points: Defining of rights to water; acquisition of rights to water; distribution of water; approval of plans for structures; supervision of construction; fixing of rates and service; supervision of financing; supervision of sale of rights.

*Defining rights.*—Since the use of water for irrigation began before any legislation providing for public control had been enacted, many valid rights to water became vested without having been defined as to nature or extent. In the absence of special provisions for deciding them, controversies over water rights went to the courts, but it early became evident that this method of handling the matter was illogical and unnecessarily burdensome as rights were never permanently settled. To meet this situation all of the States containing arid lands, except Arizona, have provided some special procedure for defining rights. There is a widespread belief that the defining of rights is a judicial matter which must be left to the courts, and this theory underlies the legislation of most of the States. A few States have enacted laws on the theory that such defining of rights is an administrative matter, and have placed it in the hands of boards or officials, while several of those which have left it to the courts have attempted to get the benefits of the administrative determination of rights while leaving the final decision with the courts.

Colorado was the pioneer State in providing a special procedure in the courts, the most important feature of this being the provision requiring all parties claiming rights to water to file statements of their claims with the clerks of the district courts of the counties in which they are located, and the provision that on petition from one or more parties interested as owners of any ditch, canal, or reservoir the district court shall proceed to adjudicate the rights of all claimants to rights from the same source, and issue certificates of rights in accordance with its findings. This plan has been adopted by many of the States, but has been abandoned in whole or in part by most of them. This plan has been much criticised because of the fact that the courts are largely limited in their findings by the claims and testimony of interested parties, and that the public, or its representative, the State, is not represented in any way in such an adjudication. It is claimed that many decrees have been based on agreements between the parties, who have apportioned among themselves a public property without reference to their legitimate claims to such property.

The correction of the defect just mentioned is the fundamental purpose of the special procedures for defining rights adopted in the other States. Wyoming was the first State to provide for the defining of water rights by an administrative board, independent of the courts. It was followed in this by Idaho, Nebraska, and Nevada, and in all these States appeal to the courts was provided for. Under this plan the board, or its agent, collects the sworn statements of claimants, makes surveys of the canals and the lands irrigated, and holds hearings, and on the basis of the claims, surveys, and the testimony determines the rights of the various claimants and issues to each party a certificate defining his rights. The Idaho and Nevada laws have been declared unconstitutional, and other systems have been adopted.

Several States have attempted to secure the advantages of the Wyoming system and still leave the matter to the courts. To accomplish this they have provided for the collection of information, the making of surveys, and the preparation of findings as to rights by State officials or boards, all to be submitted to the courts to serve as the basis for decrees defining rights. The

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States which have adopted this system in some form are California, Idaho, Nevada, New Mexico, North Dakota, South Dakota, Oklahoma, Oregon, and Utah. There remain the States of Arizona, Colorado, Montana, Texas, and Washington, which leave this matter in the courts without the aid of administrative boards or officials.

*Acquisition of rights.*—The degree to which the acquisition of water rights is supervised by public agencies has been a gradual growth, as the demand for water has increased. Many rights were acquired before there was any public control, the water users taking water without any formalities. The first step in public control was to apply to the appropriation of water for irrigation the practice of the mining districts with relation to public lands—that is, the posting of a notice at the point of intended diversion stating what was claimed. Later it was required that copies of these notices be filed in the county records. At some time in their history most of the States have had laws requiring such posting and filing, but these laws have been superseded by others greatly extending public control in all of the States except Arizona, Kansas, Montana, and Washington; but in Colorado the only advance is that copies of the notices and maps and plans must be filed with the State engineer and approved by him if they are in proper form. It will be noted that the filings represent merely the intention to perform certain acts which are necessary to the acquisition of a right to water, and consequently the records of such filings do not constitute a list of rights.

The futility of such filings as a record of rights was early recognized, and most of the arid States have provided a procedure under which a party wishing to acquire a right must apply to a State official or board for permission to divert water, submitting a full statement of his plans. He may proceed with construction only after receiving a permit to do so, and is required to submit proof of having complied with the provisions of the permit within a specified time. If such proof is satisfactory, a certificate setting forth the right acquired is issued. The States which have adopted such a system of control of the acquisition of rights are California, Idaho, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, and Wyoming.

*Distribution of water.*—Most of the States which have provided for State supervision of the acquisition of rights or for the defining of rights have provided for the distribution of water from streams by public officials. The most common system is to divide the State into divisions and districts, in each of which one or more officials distribute the water of streams in accordance with the rights which have been defined. These districts are based on drainage basins rather than political subdivisions, the effort being to have all rights to water from the same source under control of the same official. Colorado, for instance, is divided into five divisions, each containing the complete drainage area within the State of one or more streams, and in charge of distribution in each division is a division engineer. Each division is formed of several districts, each covering a part of a main stream or some tributary; and in each district is a commissioner who distributes the water, subject to the supervision of the division engineer. Appeal may be taken from any action of a commissioner to the division engineer, from him to the State engineer, and from him to the courts.

This system, with more or less modification, has been adopted by Idaho, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, and Wyoming.

In Arizona decrees are enforced by commissioners of the courts rendering the decrees. In California the water commission is to distribute water when this does not interfere with the courts; Kansas has provided for bailiffs to be ap-

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pointed by the courts issuing decrees; in Montana commissioners are appointed by the courts when petitioned to do so by the water users; and in Washington the county commissioners may appoint water commissioners to distribute the water.

*Plans and construction.*—Those States which require that application for water right be made to the State engineer or a State board require the submission of plans of the proposed works, and provide for the submitting of proof of completion of works or an inspection of the completed works to ascertain whether they conform to the law and the terms of the permits under which they are built. The laws do not, as a rule, make it clear just how much discretion the State officials have in the matter of approval of plans. In Idaho the engineer is required to approve any application which is in proper form, and apparently has no authority to require that plans shall be either feasible or safe. New Mexico, at the other extreme, requires the engineer to reject any application "if defective as to form or unsatisfactory as to feasibility or safety of plan"; and he is to withhold his certificate if on inspection he finds that the works are "not properly and safely constructed."

In Utah the State engineer is authorized to examine any ditch or diverting works during construction, and may order the builders to make any additions or alterations which he may deem necessary for the safety of persons or property. New Mexico gives the State engineer similar authority, but no other State has gone so far.

Most of the States require by law that ditch owners install and maintain head gates and measuring devices in their canals, and place on the State engineer or his subordinates the duty of enforcing these laws. The usual penalty for failure to install these structures is the refusal to deliver water to the canals not properly equipped.

Another law, common to most of the States, is the provision that dams exceeding specified heights may not be built without the approval of the plans by some State official. The laws also provide for inspection by public officials during construction, and some States provide for periodical inspections of all dams, with authority to require repairs when needed. Colorado provides for annual inspection of all reservoirs and a determination by the State engineer of the quantity of water which may be safely stored in each, and makes it unlawful to store more than is authorized. The State engineer is also to examine reservoirs at other times on complaint of three or more persons.

*Fixing rates and service.*—In most States the use of water for irrigation is declared to be a public use, and irrigation companies are quite generally held to be common carriers, the theory being that the water rights belong to the farmers who actually use the water and that the companies act merely as carriers. In accordance with this theory most of the States have provided for the fixing of rates for carrying water by some public authority. Originally this power was lodged with the county commissioners.

The newer legislation on this subject has placed this power in the hands of State officials. In California and Nebraska rates are fixed by the railway commissions, and in Texas by the State board of water engineers.

*Financing irrigation enterprises.*—Public supervision of the financing of irrigation enterprises is limited almost entirely to operations under the Carey Act and irrigation districts. As others are to discuss these subjects, the provisions of law covering them will be merely mentioned. Except that the organization of irrigation districts is in most States initiated by petitioning the county commissioners, and the county officers are to levy and collect assessments if district officials fail to do so, there has been little public supervision of these districts. Recently, however, there have been attempts to better the financial standing of

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irrigation district bonds by providing for some measure of State supervision. The laws of California, Idaho, Nebraska, and Oregon contain similar provisions on this point. In each of these States petitions for the organization of irrigation districts are to be referred to the State engineer, and he is to report when he deems advisable. After organization and before bond elections plans are to be submitted to the State engineer, and again he is to make such report as he deems advisable. It will be noted that in neither case has the engineer any power to veto the organization or bond issue, but it is altogether likely that an adverse report by the State engineer would defeat the organization or the bond issue, as the case might be. In New Mexico the State engineer is to examine the reports of engineers employed by the districts and certify to the accuracy of these reports if he finds them accurate. If he finds them inaccurate he is to disapprove the reports, but appeal may be taken to the courts.

California alone has provided for the certification of district bonds by public officials. An irrigation district bond commission has been created, and districts may, if they so desire, submit their bonds to this commission. If the commission finds that certain conditions are met by the district the bonds are certified and become legal investments for certain public and semipublic funds. The State does not, however, assume any financial responsibility for the bonds certified.

In each of the States accepting the so-called Carey Act the selection of lands and the making of contracts for their reclamation is placed in the hands of a State board, and this board exercises some supervision of the activities of companies building works, but this is discussed in another paper.

Idaho alone provides for supervising the sale of water rights. Parties wishing to sell water rights must file plans with the State engineer and apply to the State board of land commissioners for permission to sell rights. The engineer is to report to the board and the board is to determine the number of rights which may be sold and the form of contract which may be used.

*Beneficial use.*—It will be noted that the public control outlined in this paper relates principally to rights and their enforcement and the equipment for bringing water to the land to be irrigated and not to the actual use of the water. In theory rights to water are limited to the amounts which can be beneficially used for the purposes specified and on the land to which the rights attach, but up to this time the States have done little to enforce this theory. Most of them fix the maximum amount which may be used and also prohibit waste, but otherwise do not attempt to control the amount of water used. There has been considerable discussion of means of securing economy in the use of water, and some extension of the authority of the State officials to enforce economical use. Many, the writer among them, believe that the adoption of some system which will make it to the interest of the water user to economize will be more effective and will obviate the bitter feeling which will inevitably accompany any attempt of a State official to substitute his judgment for that of the farmer as to the quantity of water which should be used within the legal limit.

It will be seen from what has been said that there has been a constant expansion in the extent to which the use of water for irrigation is controlled by public authority. Contemporaneous with the expansion has been the expansion in the area subject to a single control. The original unit was the community or "diggings" of the miners. The first step beyond this was to grant a limited measure of control over irrigation to the county commissioners of the various counties; later State-wide control was adopted in one State after another until of the States containing arid land only Arizona, Montana,

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and Washington are without such provisions. As irrigation has extended conflicts have arisen over the use of interstate streams, and the same reasons which led to the adoption of State control have been urged for national control, at least of interstate streams. Up to this time such conflicts have been settled in the United States courts, and to that extent we now have national control in this country. In the most famous of the cases involving interstate streams, the Kansas-Colorado case, the United States Supreme Court based its decision not on the laws of either State, but on an "equitable apportionment of benefits between the two States."

It appears, therefore, that while in theory our States are sovereign and each has control of the nonnavigable waters within its boundaries, we have in fact a national control as between the States, and that when occasion arises the United States courts will ignore State control to bring about an "equitable apportionment of benefits."

The CHAIRMAN. The paper that we have just listened to is a clear and logical statement of public control of irrigation in the United States. The paper is now open for discussion.

Mr. FULLER. Mr. Chairman, I should like to ask Mr. Teele if any definite steps have been taken toward the adjudication of international rights on international streams. I suppose there have been a number of interesting cases to come up. Has there been any definite policy adopted where adjudication has been proposed?

Mr. TEELE. That would be entirely a matter of treaty between the United States and the other country bordering on the stream. There is a commission that is considering the rights of the two countries—this country and Canada—on the Milk River. I do not think it has ever arrived at a decision. There is, of course, the International Boundary Commission, which has to do with the rights on the Rio Grande, but any binding decree would have to be a matter of treaty between the countries rather than of any court which is in existence.

Mr. FULLER. Where such adjudications require the expropriation of water, for instance, it may have been done by treaty. Do you believe the courts would ultimately decide upon the basis of beneficial use to each of the different countries, or on what basis would those rights be adjudicated?

Mr. TEELE. I think it would have to be purely a matter of agreement. The Supreme Court has said in this Colorado suit that an equitable portion of the benefits should be the basis, rather than any beneficial use. I might add one statement relating to the Colorado, which is the only stream with which I am familiar. The Rio Grande and the Colorado both enter into the question as being between the United States and Mexico. On the Colorado the topography is such that it is necessary to run the main canal for a large area in the United States through Mexican territory, and in order to obtain permission to do this it was necessary to make an agreement allowing 50 per cent of all water to be used on Mexican soil in Lower California at any time it was needed. That holds to this day. My

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understanding of the agreement on the Rio Grande is that the water which is allowed Mexico from the La Butte Reservoir is not based upon beneficial uses they have made of it, but, because of their distance from the water supply, they are entitled to a certain share of it.

Mr. FULLER. It seems to me that it is very imperative that those international rights be adjudicated in the proper manner as soon as possible. Take, for example, the Colorado River situation. According to the treaty, the Colorado River was to be left a navigable stream. According to the Army or the Navy Board, they have never granted a right either to Mexico or to the United States to utilize any of that water for irrigation if it interferes with navigation. The Colorado is not navigable from Yuma down to the Gulf. It seems to me that at some future time there will arise complications which must involve the expropriation of rights that are now in use. Then, if the plan for adjudication of these rights is based on beneficial use or on equitable benefits to the various States involved, it is going to demand the taking away or the expropriation of some of these rights in one country and giving them to another. There is a question of international law that is going to become very serious. Those questions ought to be adjudicated at the earliest possible moment.

The CHAIRMAN. Are there any further remarks on this topic? If not, we will proceed to the presentation and discussion of resolutions. The paper by Mr. A. E. Chandler on "The relation of riparian rights to the utilization of streams for irrigation," will be presented as read by title.

## THE DOCTRINE OF RIPARIAN RIGHTS (IN THE WESTERN UNITED STATES).

By A. E. CHANDLER.

*State Water Commission, San Francisco, Cal.*

It is intended in this paper to present a few notes regarding the doctrine of riparian rights, to the use of water, as it is now recognized in the western part of the United States, where irrigation is generally practiced.

The old English common-law rule that the waters of a stream must be allowed to flow unimpaired in quality and undiminished in quantity has been modified. The new rule as determined by the supreme courts of the Western States is well illustrated by the following from McEvoy *v.* Taylor (105 Pacific Reporter, 851), decided by the supreme court of Washington:

* * * These rights are now well established. Each riparian owner is entitled to a reasonable use of the waters as an incident to his ownership, and, as all owners upon the same stream have the same right of reasonable use, the use of each must be consistent with the rights of others, and the right of each is qualified by the rights of others.

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The modified riparian doctrine, based as it is on reasonable use, seems to the student who does not dwell in an arid section an expression in keeping with the best spirit of conservation. To realize its shortcomings one should visit an irrigated valley in any of the Western States and attempt to picture what would have been the result if irrigation had been restricted to the lands marginal to the stream. Many of such streams are so long that under a strict enforcement of the modified riparian rule no owner could have sufficient water to be of even meager benefit. On account of the scarcity in water supply and the need for irrigating the lands distant from a stream the call for a doctrine different from the riparian doctrine is imperative. The western doctrine of prior appropriation has thus far met every requirement and, owing to its flexibility, is certain to continue so doing.

The western irrigation States recognizing the doctrine of riparian rights are California, Kansas, Montana, Nebraska, North Dakota, Oklahoma, Oregon, South Dakota, Texas, and Washington. Rights to the use of water may be acquired in these States by appropriation also, but such right is inferior to the riparian right. In Arizona, Colorado, Idaho, Nevada, New Mexico, Utah, and Wyoming the doctrine of riparian rights is no longer followed, and rights to the use of water may be acquired by prior appropriation only.

The doctrine of prior appropriation is an outgowth of the mining period in the Western States. At the time gold was discovered the mineral lands were the property of the United States, and prospectors took possession of such lands, or claims, under rules and regulations fixed by themselves. In the same way the practice of "appropriating" water was initiated, and the possession of both the mineral claim and the water right was based upon priority.

As in the well-settled eastern part of the United States the common-law rule of riparian rights had been long accepted by the courts, conflict between the old and the new system of water rights in the Western States was inevitable. The States now recognizing the riparian doctrine are those on the extreme east and extreme west of the strictly arid section, while those States rejecting the doctrine are well within that section. It is only logical that the judges in the latter States should have early realized the unsuitability of riparian rights, while those in the semihumid States should have failed to appreciate the necessity for a rule not applied in the Eastern States. The leading western case upholding riparian rights is Lux *v.* Haggin (10 Pacific Reporter, 674), decided in California in 1886 by a divided court of four to three. It now seems certain that if the decision had been delayed but one decade the result would have been otherwise. The only supreme court to change its attitude regarding riparian rights was that of Nevada, and mention is here made of two cases, one decided in 1872 and the other in 1885, to illustrate the effect contact with the actual necessities of an arid State has had upon the judicial mind.

In the case of Vansickle *v.* Haines (7 Nevada, 249) the supreme court of Nevada found it necessary for the first time to definitely decide which was the uppermost doctrine in Nevada, and decided in favor of riparian rights. That the court found it necessary to follow the law as established in the Eastern States is evident from the following extracts from the opinion of Mr. Chief Justice Lewis and the concurring opinion of Mr. Justice Garber:

Lewis, C. J.: Indeed, the whole argument is based upon the assumption that the riparian proprietor has no right to have a stream continue its flow through his land unless he has some special use to make of it, or has made some particular appropriation of it; whereas every case which has ever come under the observation of the courts (and they are numerous) holds the contrary. (P. 278.)

Garber, J.: Unfortunately, this is not a case which such common error can be said to have made itself law; and after as thorough an investigation as I am capable of making, I feel constrained to concur in the position so fully

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elaborated by the chief justice, that on every point essential to the case of the petitioner, not merely the weight of authority, but all the authorities, are against him. Against a clear and explicit rule of law, no arguments from inconvenience, however forcibly urged, can prevail. (P. 290.)

In the later case of Jones *v.* Adams (19 Nevada, 78) the conflicting doctrines were again before the supreme court of Nevada. During the interim the supreme court of Colorado had abrogated the doctrine of riparian rights for the reason that it was unsuited to the natural conditions. This view was reflected by Mr. Justice Hawley, who wrote the opinion in Jones *v.* Adams, as is shown by the following:

In all the Pacific coast States and Territories, prior to the passage of the act of Congress of July 26, 1866, the doctrines of the common law, declaratory of the rights of riparian proprietors respecting the use of running water, was held to be inapplicable, or applicable to only a very limited extent, to the wants and necessities of the people, whether engaged in mining, agricultural or other pursuits; and it was decided that prior appropriation gave the better right to the use of the running waters to the extent, in quantity and quality, necessary for the uses to which the waters were applied. (P. 84.)

The case of Vansickle *v.* Haines, is so far as the same is in conflict with the views herein expressed, is hereby overruled. (P. 88.)

It is very common to-day to hear the statement that the riparian doctrine is no longer recognized in any of the Western States. This is probably due to the fact that irrigation projects of large proportions are being successfully operated in the States recognizing the riparian doctrine, which is especially true in California, Oregon, and Washington. A study of the California case of Miller & Lux *v.* Madera Canal Co. (99 Pacific Reporter, 502), of the Oregon case of the Eastern Oregon Land Co. *v.* Willow River Land & Irrigation Co. (201 Federal Reporter, 203), and of the Washington case of Still *v.* Palouse Irrigation & Power Co. (117 Pacific Reporter, 466) must result in a contrary view. The following statement of the court in the California case has been adopted as the law in the Oregon and Washington cases:

What the riparian proprietor is entitled to as against nonriparian takers is the ordinary and usual flow of the stream. There is no good reason for saying that the greatly increased flow following the annually recurring fall of rain and melting of snow in the region about the head of the stream is any less usual or ordinary than the much diminished flow which comes after the rains and the melted snows have run off.

The doctrine that a riparian owner is limited to a reasonable use of the water applies only as between different riparian proprietors. As against an appropriator who seeks to divert water to nonriparian lands, the riparian owner is entitled to restrain any diversion which will deprive him of the customary flow of water which is or may be beneficial to his land. He is not limited by any measure of reasonableness.

In each of the three cases a riparian owner enjoined storage, or diversion for storage, on the stream above him. As reservoirs must be constructed to extend the present use of water, these decisions show the riparian doctrine to be not only unsuited to natural conditions, but directly antagonistic to the best development. It must be remembered that many streams on which storage is contemplated are many miles in length, some of them even hundreds of miles. Where each riparian owner along the stream has a right to enjoin the storage of water "which is, or may be, beneficial to his land," an almost insurmountable obstacle is presented. The difficulty in passing upon reservoir projects at the present time is in ascertaining whether the lower riparian proprietor will be injured by the storage of the flood water—a question of fact rather than of law. This difficulty is well illustrated in the Oregon case, supra, as two judges of the circuit court of appeals held that injury would result, while the

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judge of the circuit court and one of the judges of the circuit court of appeals held otherwise.

The courts agree that in cases where no injury will result the waters may be diverted even to points beyond the watershed.

Although Oregon was included in the enumeration of States recognizing the riparian doctrine, its supreme court has held, in the case of Hough *v.* Porter (98 Pacific Reporter, 1083), that Congress in the desert act of March 3, 1887, abrogated the riparian right for all lands then public, as is shown by the following language from the opinion:

Construed, then, with the act of 1866 and other provisions of the act of 1877, we are of the opinion that all lands settled upon after the date of the latter act were accepted with the implied understanding that (except as hereinafter stated) the first to appropriate and use the water for the purposes specified in the act should have the superior right thereto. So far as we are able to deterimne, the question, as here presented, has not heretofore been squarely before any of the courts.

The part of the desert-land act referred to by the court is as follows:

* * * and all surplus water over and above such actual appropriation and use, together with the water of all lakes, rivers, and other sources of water supply upon the public lands and not navigable, shall remain and be held free for the appropriation and use of the public for irrigation, mining, and manufacturing purposes subject to existing rights.

With the exception of California, a very large proportion of the riparian lands in the Western States was settled upon since March 3, 1877 (the date of the approval of the desert land act). If the other States were to follow Oregon, therefore, a great deal of the trouble over riparian rights would be eliminated.

The only other State supreme court which has commented upon the interpretation of the desert-land act in Hough *v.* Porter is the supreme court of Washington in Still *v.* Palouse Irrigation & Power Co., in which it is said, in respect to the language quoted above from the desert-land act:

This contention has been suggested by two Oregon cases—Williams *v.* Altnow, 51 Or. 275, 95 Pac. 200, 97 Pac. 539, and Hough *v.* Porter, 51 Or. 318, 95 Pac. 732, 98 Pac. 1083, 102 Pac. 728. The act itself manifestly relates only to the reclamation of desert lands and confines the use of the water to the amount "actually appropriated and necessarily used for the purpose of irrigation and reclamation," such right to be determined by bona fide prior appropriation.

The Supreme Court of the United States in Boquillas Cattle Company *v.* Curtis (213 United States, 339), deciding an Arizona case, spoke of the Hough *v.* Porter decision as follows:

The opinion that we have expressed makes it unnecessary to decide whether land in the arid regions patented after the act of March 3, 1877 * * * are not accepted subject to the rule that priority of appropriation gives priority of right by virtue of that act construed with Revised Statutes 2339. The supreme court of Oregon has rendered a decision to that effect on plausible grounds.

When the United States Supreme Court refers to a decision as having been rendered on "plausible grounds" it may be confidently accepted that the ground are plausible. As any riparian owner may convey the riparian right separately from the land, Congress may do so for the public lands. Although the desert-land act deals only with the disposal of desert lands under conditions therein provided, it was eminently proper for Congress, in the same act, to dispose of all riparian rights attached to lands then public.

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Every Western State has statutes governing the appropriation of water. In some of these the statutes provide for complete control by a central office, while in others the old California method of merely posting a notice is still followed. The supreme court of Nebraska in Crawford *v.* Hathaway (93 Northwestern Reporter, 781) held that a Nebraska statute providing for the appropriation of water abrogated the riparian doctrine for all lands then public. In all those States where there are not special statutes which recognize riparian rights, it would seem that the opinion of the Nebraska Supreme Court should be followed.

In the case of Lux *v.* Haggin (10 Pacific Reporter, 674) the California Supreme Court refused to hold that the appropriation statutes of 1872 abrogated the riparian right, for the reason that the statute provided "the rights of riparian appropriators are not affected by the provisions of this title." Although this particular provision was later repealed no serious attempt has been since made to have the California Supreme Court rule upon the point involved.

Although outside of Nebraska the courts have not held that the statutes authorizing appropriation of water abrogated the riparian right of all lands then public, the rule is well established that appropriations made while riparian lands are unentered public lands (State or National) are not subject to such riparian rights. The following from the recent California case of Duckworth *v.* Watsonville Water & Light Co. (150 Pacific Reporter, 58) is in point:

> These decisions show that while an appropriation or diversion made upon lands of the United States gives the appropriator or diverter a right to the water as against the United States, it does so solely because, by the act of Congress of July 26, 1866 (14 U. S. Stats. 253), the United States declared that such diversion, if recognized by local laws, should be effectual to confer upon the diverter the riparian rights in the stream pertaining to the land of the United States abutting thereon, that it gives no right as against other landowners, that this does not take place upon the theory that the water is held by the United States for public use, but because, as proprietor of the land, the United States, by that act, granted a part of its property in its land to such diverter. Also they show that the appropriator under the code may obtain a similar right as against riparian rights of the State pertaining to any lands which the State may own along the course of stream; but that this right may be thus acquired, solely because the State in section 1410 of the Civil Code has so declared and that this declaration binds the State as to its proprietary lands, but does not affect lands of other persons or water rights pertaining to such other lands, and that, except its riparian rights pertaining to lands which it owns bordering upon nonnavigable streams, the State has no right to the waters thereof and, consequently, cannot dispose of any other rights.

As the riparian owner has so superior a right when compared with that of the mere appropriator, it becomes necessary to determine how far from the stream the riparian lands extend. With the exception of a single Oregon case, the courts hold that the riparian lands are restricted by the limits of the watershed. The supreme courts of California, Nebraska, and Texas have further limited riparian lands to the tract described in the patent from the Government (Federal or State), part of which tract touches the stream. The California Supreme Court has further limited the lateral limits to the smallest parcel at one time in a single ownership, unless the conveyances specify otherwise. As 40 acres is the smallest subdivision recognized in subdividing public lands, the supreme court of Nebraska has suggested, although not decided, that the 40-acre tract touching the stream should be the limit of the riparian lands.

Legislation intended to abolish riparian rights can be effective only for the lands at the time public. As one of the most objectionable features of the

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right is the power to hold it without actually using the water, suggestions are often made to fix by statute the period of nonuse which shall cause a forfeiture of the right. The present water commission act of California (in effect Dec. 19, 1914) provides that the nonapplication of water to beneficial purposes upon riparian lands for any continuous period of 10 successive years shall be deemed to be conclusive presumption that the use of such water is not needed upon said lands. It is, of course, too early for the provision to have been passed upon by the courts. The supreme court of South Dakota has held in St. Germain & Co. *v.* Hawthorne D. Co. (143 Northwestern Reporter, 124) that a statute providing that, when a party entitled to the use of water fails to beneficially use all or any portion of the waters claimed by him for a period of three years, such unused waters shall revert to the public, is void as to a riparian owner but valid as to mere appropriators. It said: "A riparian right to use such waters of a flowing stream can not be lost by disuse.

It has been suggested above that the doctrine of riparian rights would not now be recognized if the courts in the early cases had the present-day knowledge of the needs of our irrigable sections. The California supreme court in Katz *v.* Walkinshaw (74 Pacific Reporter, 766) rejected the common-law rule of percolating waters for the very same reason that courts in the strictly arid States abolished the doctrine of riparian rights. In the Katz case the supreme court said:

> Whenever it is found that, owing to the physical features and character of this State, and the peculiarities of its climate, soil, and productions, the application of a given common-law rule by our courts tends constantly to cause injustice and wrong, rather than the administration of justice and right, then the fundamental principles of right and justice on which that law is founded and which its administration is intended to promote, require that a different rule should be adopted, one which is calculated to secure persons in their property and possessions, and to preserve for them the fruits of their labors and expenditures. The question whether or not the rule contended for is a part of the common law applicable to this State depends on whether it is suitable to our conditions under the rule just stated.

It is hoped that all who read this paper will avail themselves of an opportunity to study the relative merits of the doctrine of riparian rights and that of prior appropriation by an actual inspection of conditions existing in the Western States. It is believed that the study will result in the positive opinion that the recognition of riparian rights causes "injustice and wrong" and that it is nowise "suitable to our conditions."

The CHAIRMAN. We shall now proceed to a discussion of the resolutions to be presented to this subsection of Section III. I will call upon the chairman of the committee to report on the resolutions that have been considered.

Mr. TEELE. Mr. Chairman, the committee drafted two resolutions which include most of the ideas in all of the resolutions that were submitted. The first one I shall read was suggested by Mr. Mercau, the delegate from Argentina, and proposes a commission to study laws relating to the use of water (reading):

> Whereas the natural laws underlying the use of water for irrigation, industrial, and other purposes are uniform and independent of national boundaries; and

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Whereas, the study of the governmental laws and local regulations and customs of the various nations and the desired changes therein may be made mutually helpful; therefore, be it

*Resolved*, That each of the American nations appoint a commission with instructions to study the existing laws and regulations governing the use of water, and that such commissions be requested to communicate the progress and results of their labors to each other and to unite upon a general report to be submitted to the next succeeding Pan American Congress.

The CHAIRMAN. What shall we do with the resolution as read?

Mr. FULLER. I move that it be adopted, Mr. Chairman, without further discussion.

The motion was seconded.

The CHAIRMAN. It has been moved and seconded that the resolution as read be adopted. Is there any further objection? All in favor say aye. The ayes have it. We shall now proceed to the second resolution.

Mr. TEELE (reading):

Whereas the surest foundation for national prosperity is a land-owning agricultural population; and

Whereas one of the highest functions of the State is to provide conditions under which its growing population may acquire homes on the land; and

Whereas there are in all Pan American countries large areas of unutilized land, the reclamation of which will permit of the necessary expansion within existing territorial limits; and

Whereas private development unaided by the State has not yielded financial returns such as will induce large capital to continue in this field; and

Whereas the creation of homes and national wealth in places now waste is of great public importance; be it

*Resolved*, That the American nations should extend substantial aid in the gradual reclamation of these waste lands as the demands of increasing population require.

I move the adoption of this resolution.

The CHAIRMAN. Do we have it seconded?

Mr. FULLER. I will second it, but I do not know whether I ought to, because it does not seem to go much into detail.

Mr. TEELE. I will say that Dr. Fortier has prepared a draft of the resolution which went into more detail. It was the opinion of the committee that a resolution should be expressed in more general terms, and that we should not go so far as to pass a resolution in detail based on United States experience which might not fit at all the conditions in some of the South American countries. For that reason it seemed best to have it in such general terms as those in which the resolution was drawn.

The CHAIRMAN. In preparing my tentative resolution I did it with a view to meeting conditions in the United States. As Mr. Teele states, it may be wise to pass general resolutions that would be applicable to a large number of Republics in this continent.



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Mr. TEELE. We discussed that point quite a good deal in committee. We, of course, could include all that was in Dr. Fortier's original resolution, but it seems best, after this discussion, to adhere to the general statement, as I said before.

Mr. FULLER. Wouldn't it be wise to just put in there all of the data, and then when something is needed to carry out any purpose of this congress Pan America will have as evidence this resolution in which we concur?

The CHAIRMAN. In reply to that I might state, Mr. Fuller, that in a paper which was forwarded to this subsection by Mr. Grunsky, of San Francisco, he advocates the creation of a board of public works as a State department and would authorize this board to construct works and maintain them. I am inclined to think that we will get into difficulties if we go far into details, particularly as regards the needs of this country with which we are more familiar than with other Republics.

Mr. FULLER. I second the motion on the resolution.

The CHAIRMAN. It has been moved and seconded that the resolution as read be passed. Is there any further discussion? You have heard the motion. All in favor say "Aye." The ayes have it, and the motion is carried. What is your further pleasure? This terminates the business of the morning session, I believe.

Mr. FULLER. I move we adjourn.

A VOICE. I second the motion.

The CHAIRMAN. We stand adjourned.

Thereupon, at 11.45 o'clock, the subsection adjourned sine die.

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## SESSION OF SUBSECTION 6 OF SECTION III.

RALEIGH HOTEL,
*Wednesday morning, January 5, 1916.*

Chairman, GEORGE M. ROMMEL.

GENERAL TOPIC:

**Pan American Theme: "Pan American Cooperation in Plant Quarantine."**

The session was called to order at 9.30 o'clock by the chairman.

The CHAIRMAN. Ladies and gentlemen, I need not assure you of the pleasure that it gives me to preside over the meeting of this subsection. We have two or three papers on the program, an abstract of which will be presented before we proceed to the more formal and detailed discussion of the subject of the morning's meeting. I will ask Mr. John R. Johnston, of the agricultural experiment station, Santiago de las Vegas, Cuba, to present the first paper, which is entitled "Pan American cooperation in the quarantine of plants," by Mr. Roberto Sundberg, director de la Defensa Agrícola, Montevideo, Uruguay.

### COOPERACIÓN PANAMERICANA EN LA CUARENTENA DE LAS PLANTAS.

Por ROBERTO SUNDBERG,

*Director de la Defensa Agrícola del Uruguay.*

La Conferencia Internacional de Defensa Agrícola celebrada en Montevideo en mayo de 1913 y a la cual concurrieron con representantes nueve naciones del Continente sud americano, aprobó las tres convenciones siguientes:

Primera. Convención relativa a la exploración de los focos de origen de la langosta.

Segunda. Convención Internacional de Defensa Agrícola.

Tercea, Convención Internacional de Defensa Agrícola relativa a plagas desconocidas.

La primera de las convenciones citadas tiene un gran interés para los países que periódicamente se ven amenazados por la gran plaga de la langosta, contra la que muchas veces resultan inútiles todos los esfuerzos para combatirla y los propósitos fijados en la convención, al realizarse, podrán poner en claro una serie de problemas de gran interés para la economía de las naciones amenazadas,



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problemas que, aunque no dejan de ser también de interés general, no preocupan seriamente a los países que se hallan libres de las devastadoras incursiones del acridio.

Las segunda y tercera convenciones, es decir, la Internacional de Defensa Agrícola y la relativa a Plagas desconocidas deben considerarse de interés universal y ya que la mayoría de los países han organizado y organizan, día a día prestándole mayor atención, los servicios de profilaxia y sanidad vegetal, convendría que pudiera llegarse a un convenio mutuo, entre todas las naciones americanas, uniformando los procedimientos de inspección y adoptando modelos semejantes para los certificados.

La segunda convención aprobada en Montevideo responde al propósito formulado por el presidente de la Subsección de la Conservación de la Industria de las Plantas, Sr. Don David Fairchild y en mérito a que ya ha recibido la aceptación de ocho representantes de naciones sudamericanas y a que la substancia de sus artículos debe interesar al resto de sus hermanas del Sur y del Norte, nos proponemos al analizarla muy sumariamente, llamar la atención sobre la misma para que se consiga la adhesión de los países no representados en la conferencia, llenándose con ello la alta finalidad perseguida.

Un servicio eficaz de cuarentena del punto de vista esencialmente práctico, es de difícil control, si se limita a la inspección de entrada en los países importadores. Por excelentes que sean los medios puestos en función y por meticulosos los agentes del servicio, muchas veces podrá escapar al ojo experto la presencia de una afección de carácter peligroso para los productos vegetales ya que la naturaleza misma de muchas plagas, especialmente las criptogámicas, no manifiestan su presencia sino en una forma que prácticamente hace muy difícil su debido control. Nos colocamos en el lado esencialmente práctico, en los casos de grandes importaciones de productos en las que, por la naturaleza misma de los envíos, no es posible llevar a cabo un análisis individual de aquellos y hay que concretarse al estudio de las muestras de la partida. ¿Existe una completa garantía de que la remesa está indemne de plaga peligrosa por el hecho de que la muestra así lo esté? La práctica de la inspección de entrada no es posible considerarla como única garantía del estado sanitario, es necesario que ella sea un complemento y no el medio único de control. Para lograr una eficaz solución se requiere la inspección de los plantíos y la liberación del certificado de origen, despachado en el país exportador y que acompañando a los productos, constituye de por sí la mejor garantía de las condiciones del producto a importarse.

Estos certificados sanitarios de origen sólo podrán admitirse si son otorgados por delegados oficiales competentes y esto implica, desde luego, que los países deberán organizar y mantener servicios análogos de fitopatología encargados de la vigilancia de los cultivos, del control de las exportaciones y de denunciar toda sospecha o descubrimiento de la presencia de plagas.

No ha escapado a la mayoría de los países de agricultura adelantada lo que dejamos indicado y se esfuerzan ellos en dotar sus organismos, los señalados servicios de inspección de cultivos a fin de satisfacer las exigencias de los países importadores que han impuesto la presentación de los certificados de origen como garantía necesaria. Luego pues, la base de una cooperación internacional en este asunto estriba, en que los países se comprometan a instalar y mantener servicios de profilaxia vegetal, de inspección, etc. Así lo exige el artículo primero de la convención de Montevideo, que dice: "Los Gobiernos de los países contratantes se comprometen a establecer, dentro de los respectivos países, los servicios de policía sanitaria vegetal destinados a la defensa de los intereses agrícolas contra las plagas de los vegetales."

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Organizados los servicios de policía vegetal, queda ahora la resolución de la forma de los procedimientos y para alcanzar el mayor resultado en beneficio de los intereses agrícolas generales y particulares, es necesario uniformar los sistemas a objeto de que encuadrándose bajo un punto de vista semejante en todos los países, se obtenga, con esa simplificación, el mayor perfeccionamiento y por ello el mayor resultado útil.

Es necesario convenir en que no deberán consentirse largas listas de enfermedades o parásitos y colocar dentro del catálogo de las plagas de la agricultura a todos los elementos que puedan dañar a los vegetales, sean insectos, criptógamas, etc. Por eso conceptuamos digno de considerarse el artículo 10 del Acta Final de la Convención del 4 de Marzo de 1914, aprobada en Roma, por el cual quedan invitados los Estados contratantes a suministrar una lista reducida de los enemigos de los vegetales contra los que se desea proteger y haciendo exclusión en la misma de todos aquellos que sin dejar de ser medios de perjuicio para la vida de las plantas, podrían obstaculizar y tal vez hacer fracasar la obra práctica de una cuarentena rigurosa y trayendo, por otra parte, como complemento, los graves inconvenientes de orden comercial por las trabas y detenciones prolongadas a muchos productos que no es posible cerrarles la entrada sin gran riesgo de exponerlos a su pérdida.

Los países importadores deberán limitarse así a indicar cuales son las plagas que serían objeto de rigurosa prevención y los exportadores garantizar aquellos que sus servicios libran al transporte los productos que provienen de lugares libres de las plagas contenidas en las listas que cada Estado formará en su interés y es para que esa garantía sea lo más segura posible el que no se obligue a los servicios de inspección de realizar una obra de investigación general, sino exigirle el que asegure la no existencia de focos de plagas dañinas y de las que se desea librar, plagas no existentes en el país importador, de dispersión limitada, fácil propagación y carácter epidémico. Y entendiéndolo así, la conferencia de Montevideo, en el artículo segundo de la convención, después de sentar lo que debe entenderse por plaga de los vegetales, agrega que así se las considerará: "cuando hayan adquirido o amenacen adquirir caracteres de expansión suficientes para producir perjuicios de importancia en las plantas."

Las obligaciones deben también extenderse por parte de los Estados a la indicación de los puertos que se librarán a la entrada y a la inspección, los puertos de exportación y tránsito. Estas obligaciones y los procedimientos adoptados por los países importadores, sus reglamentos, funcionarios autorizados, etc., que deberán recíprocamente comunicarse, quedaron incluídas en la convención de Montevideo que nos ocupa.

Por su artículo noveno, se crea un Servicio Internacional que tendrá su sede en Montevideo y al que corresponderá facilitar el cumplimiento de las convenciones. Este organismo podrá reportar un servicio de gran interés general, constituyendo el lazo de unión entre los diversos Estados y al centralizar en sus manos todo aquello que se relacione con el problema de la sanidad vegetal americana, abreviará la solución de cuestiones ligadas a la producción agrícola americana.

La tercera Convención, referente a plagas desconocidas, ha tenido en cuenta la necesidad de una protección recíproca para aquellos casos en que se hallan los países productores que no teman la aparición de plagas que no corresponden a sus cultivos comunes y sean un peligro para países vecinos, de producción diferente y para quienes pueden constituir un gran auxiliar de defensa las medidas, que a pedido de los mismos, tomen las naciones advertidas.

El problema de la cuarentena de las plantas, bajo el punto de vista Panamericano, debe encararse pues, sobre la base de la organización y sosteni-

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miento de instituciones oficiales de policía sanitaria vegetal; del otorgamiento de certificados de sanidad y origen y del control de inspección de entrada, quedando este último servicio librado, en su forma y reglamentación, a las disposiciones que le convenga adoptar a cada país importador. Lo primero es necesario que se instituya sobre una base análoga de servicios para obtener la mayor finalidad práctica y habiendo resuelto la Convención Internacional de Defensa Agrícola de Montevideo la fórmula, creemos que aceptándola los países americanos se hallaría la que es de conveniencia internacional para la protección de los intereses agrícolas.

Transcribimos a continuación el texto de las dos convenciones de Montevideo, de verdadero interés panamericano.

CONVENCIÓN INTERNACIONAL DE DEFENSA AGRÍCOLA.

ARTÍCULO 1°. Los Gobiernos de los países contratantes se comprometen a establecer, dentro de los respectivos países, los servicios de policía sanitaria vegetal destinados a la defensa de los intereses agrícolas contra las plagas de los vegetales.

ART. 2°. Se entiende por plaga de los vegetales, para los efectos de la presente convención, los parásitos, las malezas, las aves y animales perjudiciales y toda causal de estado patológico o daño ocasionado por criptógamas, insectos y otros animales, cuando hayan adquirido o amenacen adquirir caracteres de expansión suficientes para producir perjuicios de importancia en las plantas.

ART. 3°. En cumplimiento de lo dispuesto en el Artículo 1° sobre la creación de los servicios de policía sanitaria vegetal y para los efectos de la importación, exportación y tránsito de los productos agrícolas, las Altas Partes Contratantes se comprometen a fijar los puertos de importación y a dictar las medidas de control a que quedarán sometidos estos productos.

ART. 4°. Los países signatarios se obligan a no autorizar la exportación a los demás países contratantes, sin dar cumplimiento a las exigencias de los servicios sanitarios del país importador y a no aceptar otros certificados de sanidad y de origen que los expedidos por los servicios sanitarios oficiales, debiendo comunicarse recíprocamente cuales son los funcionarios autorizados y con oportunidad, las modificaciones y cambios que se introduzcan al respecto.

ART. 5°. Los certificados sanitarios deberán declarar la no existencia de plagas en el plantío o sementera de donde proceden las plantas o partes de las mismas para las cuales se expiden, el nombre del propietario u ocupante de la finca, situación de esta última, número y especie de las plantas a que corresponde, el puerto de embarque y desembarque y el nombre y dirección del destinatario.

ART. 6°. Los Estados contratantes se comprometen a comunicarse las leyes y reglamentos de sanidad vegetal que dictasen los respectivos países y las modificaciones que introdujeran, la existencia y desarrollo de las plagas, como igualmente la aparición de nuevas y extinción de antiguas y todo rechazo y destrucción que se hicieren de productos destinados a la importación, informando sobre la procedencia y causas que motivaron dichas medidas.

ART. 7°. Las procedencias de los países adherentes quedan sujetas a las prescripciones de la presente convención y a las que cada país importader estime por conveniente.

ART. 8°. La segunda Conferencia Internacional de Defensa Agrícola tendrá lugar en la ciudad de Buenos Aires, correspondiendo al Gobierno de la República Argentina los trabajos de convocatoria y organización para la fecha que considere más conveniente.

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ART. 9°. Créase una Oficina Internacional de carácter permanente encargada de facilitar el cumplimiento de las presentes convenciones y de servir de intermediaria entre todas las oficinas técnicas de los países adherentes.

Tendrá su asiento en Montevideo y se compondrá de un ingeniero agrónomo designado por el Gobierno del Uruguay y de los representantes diplomáticos de los países sudamericanos acreditados ante este Gobierno.

Los gastos que origine su sostenimiento se distribuirán por partes proporcionales a la población entre todos los países signatarios.

El mismo cuerpo directivo de la Oficina dictará su reglamento.

ART. 10° El protocolo de la presente convención, queda abierto para que puedan acceder a ella los países no representados en esta conferencia.

La accesión será notificada, por la vía diplomática, al Gobierno de la República Oriental del Uruguay, y por medio de éste a los Gobiernos signatarios.

ART. 11. La presente convención será ratificada y las ratificaciones serán depositadas en Montevideo, en el más breve plazo posible.

Entrará en vigor en cuanto sea promulgada, de conformidad con la legislación de los Estados signatarios.

### CONVENCIÓN INTERNACIONAL DE DEFENSA AGRÍCOLA RELATIVA A PLAGAS DESCONOCIDAS.

ARTÍCULO 1°. Por denuncia o a pedido de cualquiera de los Gobiernos, los demás países contratantes quedan obligados a tomar medidas prohibitivas respecto de la importación de plagas de fácil propagación, cuya existencia no sea conocida en los países adherentes productores y hasta tanto no hagan su aparición en ellos, y cuyos vehículos no tengan desinfección eficaz y práctica.

ART. 2°. El protocolo de la presente convención queda abierto para que puedan acceder a ella los países no representados en esta conferencia.

La accesión será notificada por la vía diplomática al Gobierno de la República Oriental del Uruguay, y por medio de éste a los otros Gobiernos signatarios.

ART. 3°. La presente convención será ratificada, y las ratificaciones serán depositadas en Montevideo en el más breve plazo posible.

Entrará en vigor en cuanto sea promulgada, de conformidad con la legislación de los Estados signatarios.

### CONCLUSIONES.

Sometemos a la consideración del congreso las siguientes conclusiones:

Primera, El Segundo Congreso Científico Panamericano considera de gran interés, para solucionar el problema de la cuarentena de las plantas, el que todos los países de América suscriban las Convenciones de Defensa Agrícola y Plagas Desconocidas, aprobadas en la Conferencia Internacional celebrada en Montevideo, en mayo de 1913.

Segunda. El Segundo Congreso Científico Panamericano declara de utilidad práctica el que los países americanos uniformien sus sistemas de certificados de sanidad vegetal y sus procedimientos de inspección.

Tercera. El Segundo Congreso Científico Panamericano exhorta a los Gobiernos de todas las naciones americanas para que concurran a la Segunda Conferencia Internacional de Defensa Agrícola a celebrarse en la ciudad de Buenos Aires en el año 1916.

The CHAIRMAN. In view of the fact that the program this morning is somewhat extensive and our time is not unlimited, the chair will,

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without objection, call on the papers as they appear in the program, reserving discussion of the papers until they have been presented. If there is no objection, that procedure will be followed.

I will now call on Dr. L. O. Howard, Chief of the Bureau of Entomology. The subject of Dr. Howard's paper is "The great need for the establishment of competent bureaus for the study of injurious insects in all American countries."

## THE GREAT NEED FOR THE ESTABLISHMENT OF COMPETENT BUREAUS FOR THE STUDY OF INJURIOUS INSECTS IN ALL AMERICAN COUNTRIES.

By L. O. HOWARD,

*Chief Bureau of Entomology, United States Department of Agriculture.*

The United States spends, through its Federal Department of Agriculture and its State organizations, approximately $1,500,000 a year in research work in economic entomology. Against this, a conservative estimate indicates that potential damage from injurious insects to an amount of from $50,000,000 to $100,000,000 a year is saved to the country as the result of this work.

Great Britain has established an Imperial Bureau of Entomology, and every one of her large colonies supports a competent entomological service.

Russia has started a series of regional entomological laboratories, with competent men at every one of many such laboratories engaged in studying injurious insects.

France has also a number of regional laboratories, and a very competent chief entomologist at the Institute Agronomique, at Paris.

Italy has two central stations for research in economic entomology, one at Florence and the other at Naples.

Germany and Austria-Hungary, while not having definite governmental services applying to the whole field of economic entomology, have trained men working on forest entomology and support various forest schools, and at the same time other agricultural stations of one kind or another are able to carry on needed investigations in entomology as well as other subjects relating to agriculture.

Norway and Sweden each have laboratories for the investigation of injurious insects; and the same may be said of Holland, Spain, and Portugal.

Japan, with her accustomed foresight and shrewd common sense, has for a number of years been developing a strong entomological service.

In the various Republics of Central and South America, however, there is a decided lack of work of this kind. Mexico, before her revolutionary troubles, was beginning to do good work. Argentina, supporting an excellent agricultural experiment station at Tucuman, has in its director a trained entomologist. This station, however, is not, as I understand it, supported by the general Government, but by the State government mainly through a tax on sugar cane. Brazil has an admirable institution for the study of sanitary matters, including that aspect of economic entomology which deals with insects capable of spreading disease. This institution, known as the Instituto Oswaldo Cruz, has achieved a very high international reputation, but in agricultural entomology

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this country has done but little. Peru during the past few years has supported a certain amount of entomological work, but with a change of administration it was dropped. In Chile Dr. Carlos E. Porter is doing some work, but rather more in a technical way than an economic way. Uruguay is apparently doing more work in this direction than any other South American country, but her needs are still great.

Taking Peru as an example, I am fortunate in having before me an estimate drawn up by Dr. C. H. T. Townsend, formerly employed by the Peruvian Government, in which it is shown that estimates of the damage done by insects to the principal crops of that country, founded on statistics of production and carefully computed percentages of injury by each of the various pests, are as follows:

| | | | |
|---|---|---|---|
| Sugar cane | £929,301 | The vine | £79,814 |
| Cotton | 867,607 | Coffee | 19,380 |
| Coco | 119,466 | Tobacco | 15,530 |
| Rice | 22,989 | Cacao | 3,630 |

Other crops, such as corn, beans, cereals, alfalfa, and other forage plants; citrus and other fruits, yucca, potatoes, sweet potatoes, vegetables of all classes, etc.—625,000 pounds. This makes a total annual damage to crops alone by insect pests in the Republic of Peru of £682,717, or an equivalent of about $3,413,585, United States gold.

These figures do not include the enormous losses suffered by Peru from the following causes: Locust swarms, which occur nearly every year in certain parts of the Republic; diseases of cattle, some of which appear to be transmitted by ticks or other biting insects; the practically complete elimination of citrus cultivation in the coast region of central Peru, due to certain pests, which killed off the trees some 40 years ago; the damage to rubber forests and rubber plantations by insects; and last, but not least, the immense losses in human lives, property depreciation, and retardation of development of the country's resources caused by insects which transmit such diseases as verruga, uta, malaria, bubonic plague, typhus, tuberculosis, cholera, anthrax, and others. Including these additional losses not given under the head of crops, it is estimated that the monetary value of the damage suffered by Peru annually from insects will amount to not less than £5,000,000; and it is Dr. Townsend's estimate that an annual expenditure by the Government of Peru of about £25,000 would, in the course of a few years, reduce by at least one-half this annual loss of £5,000,000. In other words, a saving of £2,500,000 every year can be effected by the maintenance of a strong Governmental service in economic entomology at the cost of only one one-hundredth of that amount.

Plainly the fact that the United States has demonstrated that it pays to support an extended service of this kind indicates that other countries will find it to advantage, in so far as their means will permit, to support work of this character. That it will pay for itself many times over has abundantly been shown. This statement is made from the standpoint of any one individual country, but it has become frightfully obvious within the past 20 years that it is of great international importance that every country should support sound scientific work in economic entomology. Mr. Marlatt, the chairman of the United States Federal Horticultural Board, has spoken or will speak concerning the necessity for perfect inspection work. Now from the standpoint of entomological research a competent inspection depends upon accurate knowledge of the special insects liable to be carried from one country to another. Thus the situation at present, owing to a lack of competent govern-

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mental research laboratories and entomological bureaus in the Central and South American countries, is that little is known concerning practically all of the species liable to be carried from one country to another. That is, little is known of intimate life histories, upon which depends the capacity for international carriage. It is perfectly obvious that any quarantine established by the United States against any South American country on account of some special pest might impose unjust restrictions upon commerce, owing to the lack of especial information of the kind needed. This is a point of the greatest importance, and of itself would justify the support of research laboratories, entirely aside from the good to be gained in the protection of crops in the individual country.

There has been a great development of late years in knowledge of the parasites of insect pests, and there have been many importations of these beneficial insects from one country to another. International courtesies of this kind have been very frequent of late, but they are almost impossible when one of the countries concerned does not possess a bureau of entomology. It is true that certain countries have sent out their explorers to different parts of the world in the search for beneficial insects, but their efforts are hampered by the need of wise local entomologists in the places in which the parasites are indigenous. Again, a country without such a service is unable properly to import and acclimatize these beneficial species except in very simple cases, as for example the importation of the Prospaltella parasite of the scale insect known as *Diaspis pentagona* from this country and from Italy into Uruguay, where a special commission has been formed for this purpose.

The international necessities are especially keen between adjoining countries, and this can be illustrated in no better way than by reference to the migratory locust outbreaks in Central America, involving Costa Rica, Honduras, and Guatemala, and the similar migratory locust outbreaks in portions of South America, involving Peru, Chile, and portions of Argentina, and some of the other countries as well. In such cases the establishment of international commissions and the joint employment by the groups of countries involved of experts to determine the exact range of the permanent breeding grounds of the species of locusts concerned, and the arrangement for a warning patrol of these breeding grounds and possibly the institution of measures of repression of locust swarms quite away from agricultural regions are obvious.

The writer urges upon the representatives of the different Central and South American countries in attendance at this congress the tremendous importance of the establishment as speedily as possible of governmental research laboratories in economic entomology in every country in this hemisphere, and he urges it not only for the good of every individual country, but he urges it more or less selfishly for the good of his own country, since he is sure that the other American republics will be able to be of assistance to this country in almost the same measure as in the future he is sure that this country will be able to help them.

The CHAIRMAN. I shall now ask Mr. Johnston to read the paper by Dr. Carlos Nocedo, of Guatemala.

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## DÍPTEROS NUEVOS PARÁSITOS DE LA SCHISTOCERCA PEREGRINA.

Por CARLOS NOCEDO.

Fué invadido el territorio de la República de Guatemala por la langosta (chapulín), que llegó del vecino Estado de México, a fines del año de 1913, coincidiendo con una escasez de lluvias extraordinaria. Pronto se extendió el "acridio" por valles, planicies y montañas, respetando tan sólo algunos lugares situados a gran altura en la cordillera de los Andes, en los que el frío es intenso y la vegetación se agosta prontamente durante la época de la sequía, que por lo general dura desde mediados de octubre hasta principios de mayo. Puede decirse que acabó con los sembrados que proporcionan la base de la alimentación a la gente campesina. Los maizales y frijolares, principalmente, fueron arrasados. Los bananales, en la zona del Norte, sufrieron muchísimo. Verdad es que la plaga no obró sola: la falta de lluvias, fuertísimos y continuados calores, y la aguda crisis provocada en todas partes por la sangrienta guerra europea contribuyeron a que se hiciese general el malestar y se encareciese la vida grandemente. Hago estas referencias a propósito de la opinión bastante generalizada y errónea, en mi concepto, de que los daños ocasionados por la langosta son insignificantes.

Nada de particular ocurrió en la vida del insecto hasta que en 1914 cayeron los primeros aguaceros. Supe entonces, por personas llegadas de algunos Departamentos, que la *Schistocerca peregrina* adulta (voladora) moría en grandes cantidades sin que nadie pudiera explicarse la causa. La fantasía y la credulidad, en íntimo consorcio, dieron lugar a que de boca en boca se propalasen las cosas más estupendas. El hecho avivó mi curiosidad y decidí consagrarme a su estudio; pero me fué imposible, por lo pronto, conseguir ejemplares vivos para tenerlos en observación y poder realizar mis propósitos. Cuando esto ocurría, una feliz casualidad me proporcionó la ocasión de examinar una esquistocerca conservada en alcohol y en la cual se veía muy bien una larva blanquecina alojada en el abdomen. Lo cosa me interesó desde entonces de tal modo que sin tener en cuenta dificultades de ninguna clase me puse a la labor inmediatamente.

Días después fuí consultado respecto del particular por el activo y bien intencionado jefe político de Retaluleu, el coronel de estado mayor Don Jorge Ubico. Con las remesas que él me hizo, y los ejemplares que por otros conductos pude proporcionarme, conseguí disponer de insectos vivos en gran número por espacio de cuatro meses.

Poco a poco al principio y rápidamente después fué generalizándose la larva en referencia. Aumentó por tal motivo la curiosidad pública y con frecuencia los periódicos locales insertaban ruegos de agricultores que insistentemente preguntaban cuál era la causa de la muerte de las langostas y ansiosos pedían un medio de exterminarlas. Para satisfacer tales deseos, y accediendo a las reiteradas súplicas del director de "El Nacional," el abogado y literato Don Miguel Ángel Urrutia, hube de proporcionarle las siguientes indicaciones, intencionalmente desprovistas de todo aparato científico, y que fueron publicadas en el número de dicho diario correspondiente al 14 de septiembre próximo pasado:

"La muerte del chapulín es ocasionada por parásitos que en él se desarrollan y que viven a expensas de la substancia grasosa de color amarillento que rodea al intestino. Cuando están próximos a transformarse en crisálidas, hieren algún órgano indispensable para la vida del insecto que los soporta y ocasionan su muerte. La crisálida, que puede quedar en el interior del individuo muerto (en

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el abdomen generalmente), o caer al suelo por efecto de la descomposición de aquél, prosigue su evolución bajo la influencia de los agentes atmosféricos.

"Pertenecen los parásitos hasta ahora hallados a los órdenes de los himenópteros y de los dípteros.

"Sufren siempre metamorfosis completas, es decir, que sucesivamente pasan por los estados de huevo, larva y crisálida antes de llegar a ser insectos perfectos.

"Hay tres moscas (dos de ellas sarcófagas probablemente) y otra muy pequeña, pero ágil y numerosísima, que parece no serlo. Además un icneumónido (pequeña avispa) mucho menos abundante. Aun no han sido rigurosamente determinados los nombres específicos de estos insectos.

"Los gusanos correspondientes a las moscas más grandes destruyen a veces la quitina que constituye los anillos ventrales y son entonces perfectamente visibles. Siempre se encuentran en los individuos adultos. Basta sujetar éstos boca arriba con los dedos pulgar e índice de la mano izquierda, y con los correspondientes de la derecha o con unas pinzas arrancar, tirando de ellos horizontalmente los dos últimos anillos del abdomen, para ponerlos de manifiesto. Los hay grandes y pequeños, pero todos son ápodos (sin patas), acéfalos y blanquecinos o grisáceos. Las crisálidas son cilindro-ovoideas, de color oscuro, pardas o negruzcas. Las ninfas correspondientes al icneumónido no han podido ser estudiadas.

"Icneumónidos y múscidos se reproducen por medio de huevos. Algunos entomófagos perforan la piel o la quitina que constituye el dermato esqueleto del animal que ha de servirles temporalmente de morada y mediante un aparato ingeniosísimo, conocido con el nombre de oviscapto, introducen el huevo en sus tejidos. Los sarcófagos no depositan huevos sino que dan a luz las larvas que han salido de aquellos en el vientre de la madre; son ovo-vivíparos. Su fecundidad es prodigiosa. En un ovario puede haber veinte mil larvas. En el estado adulto viven en los troncos de los árboles, en las flores y en todos los lugares en que se encuentran sustancias animales o vegetales en descomposición. Huyen por lo común de las poblaciones. En las casas se los halla rarísimas veces.

"Hasta ahora sólo han aparecido gusanos parásitos en las langostas adultas. Ni un solo saltón, entre centenares examinados, contenía huevos o larvas. El número de éstas varía desde uno a seis cuando se trata de las sarcófagas. De la pequeña mosca antes mencionada se hallaron hasta quince en un mismo individuo.

"La humedad, el calor, y tal vez otros agentes meteorológicos favorecen el desarrollo de los parásitos. Si la estación de las lluvias se alarga es probable que sucumba la inmensa mayoría de las langostas adultas.

"De todo lo expuesto se deduce claramente lo que convendría hacer para acelerar la destrucción de la esquistocerca peregrina. Con un poco de constancia y energía es casi seguro que el devorador ortóptero desaparecería por completo del territorio de la República. Para conseguirlo menester sería realizar, principalmente, las tres cosas siguientes:

"1°. Llevar langostas engusanadas a los puntos en que la enfermedad no haya aparecido o esté poco generalizada. El transporte habría de verificarse en cajas de madera, divididas por medio de un compartimento, y que tuviesen dos costados cerrados con tela de alambre. La rapidez del viaje sería una de las condiciones del éxito.

"2°. Señalar los lugares en que se hubiera efectuado el desove, de manera que pudiesen siempre ser reconocidos, apuntar la fecha de éste, y cuidar de destruir el saltón recién-nacido (mosquita) a medida que vaya apareciendo.

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"3°. Destruir igualmente el saltón ya existente y más desarrollado, sobre todo el voracísimo que estuviese pronto a transformarse en insecto adulto, valiéndose de los numerosos medios que se usan en otros países. Así, con un personal relativamente pequeño y gastos insignificantes, podría emprenderse con actividad la campaña antes de que cesen las lluvias. La manera como estos servicios están organizados en la Argentina, debiera imitarse. Si al soplar los primeros vientos del Norte los parásitos desaparecen habremos perdido una ocasión preciosa. Seguirá la esquistocerca campando por sus repetos, logrará reproducirse por centenares de miles y tal vez en la próxima primavera se encuentre en los más apartados lugares de la República."

Cuando estas indicaciones se publicaron aún no estaban terminadas mis investigaciones. Adrede prescindí en ellas del tecnicismo científico a fin de que pudieran ser por todos comprendidas y aplicadas fácilmente por los agricultores interesados. Necesario era descender a generalidades muy conocidas. Si ahora las reproduzco es para que el congreso pueda darse cuenta del camino recorrido desde el momento en que las primeras ideas arraigaron en mi mente hasta el día en que logré conocer los parásitos y poner de manifiesto los grandes beneficios que, según creo, pueden con el tiempo obtenerse de estos estudios.

Un punto de la mayor importancia—el primero tal vez—era saber con toda seguridad los nombres científicos de los insectos obtenidos. Careciendo de las publicacione scientíficas necesarias y sabiendo por experiencia cuán difícil era en tales condiciones determinarlos, decidí acudir en consulta al Departamento de Agricultura de Wáshington. Y así lo hice remitiendo en cajas numeradas varios ejemplares de cada uno de los dípteros obtenidos al completar el ciclo de sus evoluciones las larvas parásitas.

La carta que tuve el honor de dirigir al Señor Director de dicho centro científico, es la siguiente:

*Señor Director del Departamento de Agricultura de Wáshington.*

MUY SEÑOR MÍO: Por falta de medios apropiados (material bibliográfico modernísimo, sobre todo) no me ha sido posible determinar exactamente los nombres científicos de las tres distintas moscas que le envío. Confío en que ese centro podrá hacerlo con presteza y que Ud. tendrá la bondad de mandarme la respuesta directamente o por medio del Señor Cónsul de los Estados Unidos en esta.

El asunto es de algún interés público y científico y probablemente será tratado en una nota especial dirigida al Congreso Panamericano que habrá de celebrarse en Wáshington el 27 de diciembre próximo. Y, como el tiempo apremia, ruego a Ud. me dé la contestación lo más pronto posible.

Las moscas contenidas en la caja que lleva el número 1 son del género Sarcóphaga, probablemente. Lo que falta es averiguar el nombre específico. Corresponden a la especie Bara o pertenecen a la Arvensis Laticrus, Carnaria a alguna de las otras muchas hasta hoy clasificadas. ¿Son desconocidas?

La de la caja número 3, que es también sarcófaga, parece distinta. El tamaño la coloración y forma del abdomen, la disposición de las antenas, el carácter del epistoma, etc., autorizan esta creencia.

La cajita número 2 contiene ejemplares que deben ser del género Phora a juzgar por la disposición hacia atrás de los pelos de la frente, las patas largas y guarnecidas de vello, las alas ciliadas y otros caracteres que sería superfluo exponer detalladamente.

Espero que, andando el tiempo, los estudios que motivan esta consulta llegarán a interesar a Ud. y que de ellos podrán sacarse utilísimas aplicaciones prácticas.

Da a Ud. las más expresivas gracias y aprovecha la ocasión de ofrecerse a sus órdenes atento y seguro servidor.

(Firmado) CARLOS NOCEDO.

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La contestación, recibida el 16 de noviembre, fielmente traducida, dice así:

ESTIMADO SEÑOR: Su carta del 5 de octubre fué recibida con prontitud, y sus muestras han sido examinadas por dos expertos dipterólogos de este Departamento: el Dr. C. H. T. Townsend y el Sr. Federico Knab.

El Dr. Townsend informa que en la caja número 1 había ejemplares de *Musicina stabulans* y de una especie nueva de Sarcodexia. Esta última es un verdadero Tachinidio y probablemente vive como parásita en las larvas de lepidópteros.

El Sr. Knab informa que la caja número 2 contenía la especie *Aphiochæta scalaris* I.w. y especies desconocidas de Aphiochæta; mientras que la caja número 3 contenía *Fannia* (*Homalomyia*) *canicularis* L. La Aphiochæta pertenece a la familia Phoridæ, tal como Ud. lo presumía, mientras que la Fannia pertenece a la Anthomyiidæ. Esta es una especie cosmopolita y sus larvas viven en las substancias vegetales en descomposición; también se la ha encontrado en insectos muertos, y se alimenta de los excrementos de los animales, incluyendo la especie humana.

Vuestro, sinceramente,

(firmado) L. HOWARD,
*Jefe de la Oficina.*

No hay que perder de vista que para el Dr. Townsend es la sarcófaga de la nueva especie, de la cual conservo aún ejemplares de ambos sexos, larvas y ninfas, un verdadero taquinidio, es decir, una mosca *rápida*, *asesina*, o de *orugas*. De más está decir que con él estoy de acuerdo por completo. El nervio transversal de la punta de las alas muy visible; la cerda de las antenas articulada y desnuda al parecer a simple vista; el abdomen compuesto de cuatro segmentos, de forma oval, muy raras veces cilíndrica, y en este caso con su parte posterior en apariencia encorvada; el cuerpo guarnecido de cerdas y los ojos desnudos o provistos de pelos aterciopelados y que nunca se tocan en la coronilla son los caracteres del género Tachina. Sus larvas viven en estado parasitario (*varias á la vez* por lo general, dice Brehn) en otras larvas de coleópteros, de avispas ó de lepidópteros. "Unas salen del cuerpo de la oruga y se crisalidan en tierra; otras hacen lo mismo después que la oruga se ha convertido en ninfa; muchas se transforman en la crisálida, en las mariposas, o en los capullos de ciertas avispas; y algunas, por fin, nacen ya como larvas en cuyo estado la hembra las deposita en su anfitrión." Esto último es lo que hace la sarcófaga por mí estudiada, que es vivípara, y que se introduce en el cuerpo de la esquistocerca por los puntos de unión de los postreros anillos abdominales, probablemente, y allí se transforma en crisálida.

Ignoro si vive también en estado de larva en los capullos de mariposas, como crée el dipterólogo de Wáshington, o si puede atacar a otros *acridiodeos* y *locústidos* ya completamente desarrollados. Tampoco sé si el gusano se presentó en México y en las otras Repúblicas de Centro América. Lo probable es que la mosca haya seguido a las nubes o mangas de langostas y que su larva tuviese y tenga aún la misión de destruir a los individuos adultos por centenares de miles.

Importa averiguar cómo en condiciones ordinarias la sarcófaga vive, y si es cosmopolita o propia tan sólo de una o varias de las Repúblicas del Istmo. Aún en el caso de que su área de dispersión sea muy limitada, debiera intentarse aclimatarla en otros países. Podrían los ensayos hacerse durante la estación lluviosa en toda la América tropical y durante el verano en territorios como los de la Argentina y los Estados Unidos. Así sabríamos si las especies gregarias y migratorias que existen en el continente americano (*Esquistoceros paranensis*, *peruviana*, *peregrina* y *americana*) sucumben o no en contacto con la mosca asesina. Menester sería tener los insectos cautivos en jaulas especiales o en habitaciones que reuniesen condiciones determinadas. También podrían intentarse durante la estación apropiada, en las regiones permanentes ya bien

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conocidas, como lo son para la *paranensis* las altiplanicies situadas en el centro de Bolivia. Claro está que habría que prescindir en estos ensayos de las langostas sedentarias y que viven aisladas, bastante numerosas, según parece, y poco dañinas.

¿Pueden las langostas sedentarias transformarse en viajeras? Y en caso de ser así ¿qué causas provocan el desarrollo extraordinario y repentino de estos ortópteros? Lo ignoramos. Lo único que sabemos es que cuando una especie se multiplica en demasía otras especies enemigas se acrecen también considerablemente y se encargan de reducirla a sus justos límites. Así es como se conserva el equilibrio en el reino animal, tan variado y numeroso en estas hermosas regiones americanas apenas exploradas y que innumerables sorpresas nos reservan.

Nada indica en un principio la presencia de los parásitos en la esquistocerca; el animal conserva su agilidad y vuela perfectamente. Más a medida que la larva del díptero se va desarrollando, el abdomen se aplana o se abolla acabando por agrietarse no pocas veces en los puntos de unión de los anillos que lo constituyen. El insecto permanece entonces como aletargado, deja de comer y espontáneamente no vuela. Sólo obligado a ello se levanta para plegar pronto de nuevo las alas y dejarse caer en el suelo, o posarse en las ramas de los árboles en donde permanece casi inmóvil hasta que muere.

No sé si habré tenido predecesores en este asunto. Ya he indicado como nació en mí la idea de emprender el estudio de las larvas en referencia. Si el Sr. Lahille, en la Argentina, hizo algo en este sentido—cosa que acabo de saber someramente—la *Sarcophaga acridiarum* por él hallada debiera ser conocida por los dipterólogos de Wáshington. Y, sin embargo, a la enviada por mí y por ellos examinada, la designan tan sólo con el nombre genérico, *por ser nueva*. En todo caso sería necesario probar la indentidad de la acridiorum y la que yo envié a los entomólogos americanos. Pudiera muy bien ser que se tratase de una especie distinta, ya que diferentes son las esquistocercas que en Centro América y en la República suramericana viven. Espero que la verdad no tardará en abrirse camino.

Sabía, no he de negarlo, que distintos parásitos vegetales y animales podían destruir las langostas y sus huevos. El *Isaria ophioglossoides* que invade en Rusia los lugares en que se verifica el desove; el *Lachonidium acridiorum* que ataca en Marruecos a los insectos ya adultos y a sus huevos, y el *Entomophtora grylli*, que aparece cuando la humedad es excesiva y mata a los individuos completamente desarrollados (para citar tan sólo algunos vegetales parásitos), me eran conocidos. Tampoco ignoraba que las larvas de Mylabros, entre los coleópteros, y las de Antrax, entre los dípteros, se desarrollan en el interior de los huevos de la langosta. Conocía, entre los insectos entomófagos, la *Anthomyiia angustifrons*, que en los estados de Kansas y Misouri destruyó, en 1876, por lo menos el 10 por ciento de los huevos, y las Ydia, pequeñas moscas que viven en los terrenos arcillosos, siguen el vuelo de los ortópteros emigradores y ponen en ellos sus huevos. En cuanto al género Sarcophaga sólo tenía noticia de la Clathrata, que vive en el Norte de África y persigue a las bandadas de saltonas para depositar en ellas sus larvas. Así es como el huésped retarda el desarrollo del anfitrión provocando la atrofia de las alas y de los órganos sexuales (castración parasitaria). Tal vez el conocimiento de estos hechos contribuyó a orientarme en mis investigaciones.

Todas las larvas a que me he referido fueron extraídas por mí de las esquistocercas adultas. En distintas ocasiones pude observar huevos alargados y de color perla en la cavidad abdominal de los insectos, pero me fué imposible con-

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seguir que evolucionaran fuera del cuerpo de los mismos. Pertenecían, probablemente, a la *Muscina stabulans*, que yo creí sarcófaga por haber visto constantemente y en distintos estados de desarrollo sus larvas en unión de las que procedían de la nueva especie de Sarcodexia. Ambas se parecen de tal modo que es dificilísimo diferenciarlas; son ápodas, carnosas, blanquecinas o grisáceas, cilíndricas, con los segmentos del cuerpo poco visibles, y están provistas de dos ocelos o manchas pigmentarias. A simple vista sólo difieren en el tamaño. Las de la sarcófaga miden por término medio de 8 a 9 milímetros, y de 12 a 16 las de la stabulans.

Las especies desconocidas de Aphiochæta a que alude el Sr. Knab, fueron asimismo extraídas en estado larvario de langostas adultas y al parecer completamente sanas, al día siguiente de ser recibidas. Los ejemplares que aún conservo en alcohol y que tenían recién salidos un color gris-rosaceo, son pequeñísimos.

No puedo ser tan afirmativo por lo que respecta á la *Fannia* (*Homalomyiia*) *canicularis* L. y a sus larvas.

Una redoma grande de cristal en que tuve cautivas a las esquistocercas y cuya boca estaba constantemente cubierta con un tejido de alambre, no pudo ser examinada por mí durante varios días en que estuve enfermo. Sin que al pronto se echara de ver, murieron en este tiempo algunos individuos (no obstante estar bien alimentados), y como quedaron con los sanos, es posible que las moscas llegadas de lugares vecinos consiguieran depositar a través del alambrado sus huevos. No pude comenzar de nuevo las observaciones por carecer de las langostas necesarias. El hecho ya citado de la *Anthomyiia angustifrons* autoriza no obstante a creer que la fannia puede también vivir parasitariamente en la esquistocerca peregrina.

El desarrollo de todos estos parásitos es rapidísimo, debido sin duda alguna a la influencia del clima. Moscas obtenidas en cautividad, puestas en contacto con chapulines, depositaron en ellos huevos y larvas que llegaron a insectos perfectos en un plazo muy breve. Sabiendo cuan grande es el poder de multiplicación de estos dípteros, fácil es calcular los inmensos estragos que ocasionarían a las bandadas de ortópteros emigradores. Así se explica que en ciertas regiones de la costa, asoladas por el insecto, las moscas llegaran a invadirlo todo haciéndose realmente insoportables.

Por falta de tiempo me veo en la imposibilidad de enviar fotografías ampliadas de las especies nuevas o desconocidas. Llenaré este vacío más adelante pues creo que la esquistocerca invadirá de nuevo prontamente el territorio de Guatemala y se me presentará la ocasión de resolver algunas cuestiones que se relacionan con el presente estudio. Las personas interesadas podrían suplir esta deficiencia dirigiéndose a los Sres. Townsend y Knab, competentes dipterólogos de ese Departamento de Agricultura, quienes seguramente conservan las moscas enviadas por mí y a las cuales este trabajo se refiere.

Nada tengo que añadir a las deducciones ya conocidas y al alcance de todos que en "El Nacional" fueron publicadas. Repetidas veces logré que las moscas infestasen a las langostas encerrando juntos a ambos insectos. El contagio se verificó en toda la República con una rapidez asombrosa. En menos de dos meses la enfermedad acabó con los individuos adultos.

¿Por qué las larvas recién nacidas (mosquita) y las saltónas no fueron invadidas? Será debido a que la sustancia grasosa que rodea al intestino y que les sirve de alimento es en ellas menos abundante, o a que el animal no despide un olor tan intenso? ¿Es este realmente, como presumo, el que atrae a las sarcófagas y foras? Para contestar categóricamente a estas preguntas bastaría disimular el olor natural de un grupo de esquistocercas untándolas ligeramente con una sustancia muy olorosa y que no fuese perjudicial para el insecto, como

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las esencias de serpol o de clavo diluidas; por ejemplo, si en tales condiciones no fueran atacadas en cautividad por las sarcófagas, el experimento podría considerarse como decisivo. A manera de comprobación podría verse si despachurradas algunas langostas e impregnando con su grasa a otros ortópteros (grillodios o locústidos) eran elegidos por las moscas para depositar en ellos sus huevos o sus larvas.

Estos y otros detalles muy importantes, como la influencia de la presión atmosférica, la tensión eléctrica del aire y la acción que sobre los huevos pueden ejercer los rayos invisibles del espectro solar, no pudieron ser abordados por falta de las langostas necesarias.

No quiero terminar esta nota sin referirme a un punto que considero de la mayor importancia para conseguir la rápida desaparición de los ortópteros migradores y perjudiciales. Aludo a una idea lanzada ya aquí a la publicidad por uno de los periódicos de mayor circulación en la República: la conveniencia de que los Gobiernos de la América Central formasen una liga permanente contra la langosta, que más adelante pudiera contar con la adhesión de las naciones situadas en el norte y el sur del continente. Esta idea, acariciada por mí desde hace algún tiempo, y que a la ligera indico, es de fácil realización y de resultados inmediatos. Si las naciones negocian tratados comerciales y de propiedad literaria; por ejemplo, si se entienden por lo que respecta a la guerra, provocada las más de las veces por las conveniencias personales, la insesatez o los atávicos odios humanos, ¿por qué no han de ponerse de acuerdo tratándose de evitar los grandísimos daños que ocasionan los acrídios emigradores? Un fondo permanente constituído por cada uno de los Gobiernos; una junta central poco numerosa, compuesta de personas competentes y ajenas por completo a los cabildeos políticos, siempre alertas y tan odiosos; delegados e inspectores probos y activos que recorriesen en todas direcciones los territorios invadidos, cuidasen de la estricta aplicación de las medidas acordadas y castigasen severa y prontamente al que por egoismo o negligencia las infringiese, serían, a buen seguro, lo bastante para acabar en algunos años con plagas tan molestas y perjudiciales. Habría que estatuir algo por el estilo de lo ya puesto en práctica en la Argentina, pero simplificándolo, para que fuese menos dispendioso y adaptándolo, en la medida de lo posible, a las especiales condiciones de cada uno de los países.

Necesario así mismo sería determinar con toda seguridad las regiones anuales o permanentes de las esquistocercas que viven en el Antiguo y en el Nuevo Continente, para poder atacarlas en ellas. Las montañas Rocallosas, el Sudán Central y las mesetas del interior de Bolivia en donde se hallan respectivamente la *Caloptenus spretus*, la *Schistocerca peregrina*, y la *Schistocerca paranensis*, nos son conocidas. Si no estoy mal informado, existe un convenio entre Bolivia y la Argentina a fin de acabar con el acridio que en sus incursiones tantos daños causa al segundo de estos países. Ojalá que semejantes acuerdos se generalicen y que con el auxilio de la ciencia, constancia y buen deseo, se consiga la desaparición del más temible tal vez de los insectos.

NOTA.—Quiero hacer constar que mi predicción respecto a que la langosta invadiría de nuevo en 1916 el territorio de Guatemala se realizó por completo, y que algún tiempo después de comenzadas las lluvias (que fueron abundantísimas) aparecieron los dípteros y acabaron casi con ella. La saltona fué también contagiada, aunque en menor proporción que la esquistocerca adulta.

Después de haber escrito este trabajo he podido estudiar en detalle la biología de las sarcófagas. Abordé igualmente el problema de la reproducción industrial de las moscas (innecesaria en los países que presenten las condiciones meteorológicas de Guatemala) y tengo la convicción de que pronto será resuelto.

68436—17—VOL III——57

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The CHAIRMAN. The next paper will be by Mr. John R. Johnston, of the Agricultural Experiment Station, Santiago de las Vegas, Cuba, entitled "Cooperation between the Pan American Countries in the matter of plant quarantine service."

## COOPERACIÓN EN EL SERVICIO CUARENTENARIO DE PLANTAS ENTRE LOS PAÍSES PANAMERICANOS.

Por JOHN R. JOHNSTON,

*Presidente de la Comisión de Sanidad Vegetal de Cuba.*

Las pérdidas financieras debidas a los estragos de los insectos y de las enfermedades sobre nuestras cosechas agrícolas, quedan frecuentemente fuera de todo poder para justipreciarlas adecuadamente, pues los completos antecedentes son imposibles de obtener. Se sabe que cosechas enteras son destruídas por los insectos y hongos; y a veces, como un resultado de estos daños, desaparece una industria entera, y, con mucha frecuencia, productos de primera clase son vendibles solamente como de clases secundarias o como rezagos.

Cuba solamente en los últimos veinte años ha perdido sobre un millón de pesos, en su industria en nueces de cocos debido a la pudrición del cogollo del cocotero. Estos cálculos son basados exclusivamente en las exportaciones y serían dobles si considerásemos su consumo local.[1]

La isla de Gran Caimán perdió casi por completo su industria cocotera (2); Jamaica (3), Trinidad (4), y Demarara (1c) han perdido, de igual manera, de un modo severo debido a esta misma enfermedad. Sólo Puerto Riço y la América Central estan aun libres de ella.

En Panamá, más de 20,000 acres de terreno, limpiados y sembrados de plátanos, y que eran antes buenas tierras para el cultivo del plátano, han sido abandonadas debido a la enfermedad que se ha propagado sobre esas tierras y no permite ni la obtención de una cosecha. Más de 5,000 acres adicionales serán abandonados probablemente el año entrante. Esta enfermedad continúa extendiéndose no solamente en Panamá, sino que también en Costa Rica (5), en Guatemala, y Honduras. En Cuba la misma enfermedad causa una pérdida enorme en la producción del plátano manzano que es localmente la variedad que más gusta (6). La misma enfermedad causa serias pérdidas en Jamaica (7), Trinidad (8) y ha destruído prácticamente la industria en Surinam (9).

En muchas de las islas de las Indias Occidentales las pérdidas en la caña de azúcar han sido tan grandes debido a la enfermedad de la raíz, que el cultivo de las antiguas favoritas variedades de cañas de "Bourbon" o "Otaheite" ha tenido que ser abandonado en muchos lugares y varias cañas de semillas han sido sustituídas.

En Surinam se han sufrido severas pérdidas de la enfermedad "witches'-broom" del cacao. Las exportaciones del cacao se redujeron de 8,000,000 de libras en 1899 a un poco más de 3,000,000 de libras en 1906. Muchos otros países tienen serias enfermedades en esta misma planta. Muchos de los distritos productores de café, de la América tropical sufren seriamente del tizón del café, de la mancha de la hoja y de otras enfermedades (11).

[1] Los números entre paréntesis se refieren a la relación bibliográfica al final del trabajo.

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La industria del género Citrus es de gran importancia en Puerto Rico, Cuba, Brasil, y es importante prácticamente en casi todos los países tropicales y subtropicales. La enfermedad "la costra," que antes solo era seria en el limón está produciendo daños crecientes en las toronjas. El "citrus canker" de los citrus importados del Japón a Texas se ha extendido a los otros Estados del Golfo, costando ya al Estado de Florida una pérdida de varios cientos de miles de pesos y amenaza causar muchas más antes de ser dominada.

La industria tabacalera ha sufrido pérdidas considerables, no solamente de las enfermedades en los semilleros, sino que también en los campos de cultivo.

Es imposible decir brevemente todas las enfermedades importantes de estos países. Pero no solamente, las enfermedades producen pérdidas serias, sino que también los insectos las producen.

Entre las más importantes de éstos están la oruga perforadora de la caña de azúcar, el gusano blanco o "chicharrones," grillotalpa, langosta, el saltahojas (froghopper), el minador de la hoja del cafeto, insectos del cacao, gorgojo de la palma, y los insectos cóccidos o escamas y las "moscas blancas" o aleyrodidos, ambos en los citrus.

Estas enfermedades mencionadas son solamente algunas de las más importantes de las conocidas. De hecho en los países de las Indias Occidentales, Centro y Sud América, ha habido comparativamente muy poca investigación sobre estos asuntos. En las Indias Occidentales, Cuba, Jamaica, Puerto Rico, Trinidad y Barbados existen estaciones agronómicas que han realizado alguna labor; en la América Central muy poco se ha realizado; pero Sud América, Brasil, Uruguay, Argentina y Chile mantienen estaciones que realizan muy buenos trabajos. Casi todos los demás países realizan muy poca labor. En vista del estado incompleto de estos estudios en los países panamericanos, existe poco lugar a duda que los insectos y las enfermedades causan muchas más pérdidas que las que son reconocidas como producidas por estas causas al presente.

El establecimiento de un servicio cuarentenario de plantas es un intento para evitar la introducción de plagas e insectos. Es casi fútil el intentar extirpar o dominar las varias enfermedades y plagas hasta tanto su consecutiva introducción en el país no sea evitada. Por ejemplo, nosotros en Cuba no estaremos justificados al intentar la extirpación de la enfermedad del plátano o de la pudrición del cogollo del cocotero, a no ser que tengamos una reglamentación cuarentenaria eficiente, regulando la introducción de dichas materias del extranjero. En otras palabras, nuestro primer movimiento en el dominio de estas enfermedades debía ser el establecimiento de una cuarentena para las plantas, estando entonces en condiciones de dar comienzo a establecer las medidas para el dominio local de las mismas.

Al mismo tiempo la distribución de estas enfermedades no es conocida, y hay muchos países que no tienen establecida cuarentena alguna o servicio de inspección. Esto por consiguiente nos obliga a nosotros a inspeccionar todas las plantas que llegan al país. Si otras naciones tuvieran buenos servicios de cuarentenas o de inspección ello nos serviría para obtener los certificados de inspección y serviría al mismo tiempo para ayudarnos y facilitar el curso de nuestros trabajos aquí. En otras palabras, mientras más sean los países que acepten dichos servicios, más se ayudaría al trabajo mutuamente en los varios países que lo practiquen. La comunicación entre estos varios países es frecuente, y la oportunidad de llevar de uno a otros los insectos dañinos y las enfermedades es muy grande. Cuba, por ejemplo, tiene comercio directo con las Islas Canarias, Santo Domingo, Haití, Puerto Rico, Jamaica, Panamá, Costa Rica y los Estados del Golfo; también con Colombia, Venezuela, Trinidad,

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Barbados, con la costa oeste de Centro América con la porción oeste de la costa de los países de la América del Sur. Todos los países sudamericanos tienen relaciones comerciales unos con otros.

En todo este tráfico hay un gran comercio de plantas y de productos de plantas. Las plantas vivas, usualmente en forma de almáciga, es un medio importante de transmisión de enfermedades e insectos. Las estacas de la caña, las almácigas del género Citrus, aguacates, los ñames de plátanos, los cocos en su cáscara,—todo esto es embarcado de puerto en puerto en la América tropical y frecuentemente llevan consigo tanto los insectos como las enfermedades. Las papas, frijoles, habichuelas, y el café pueden llevar gorgojos y otros insectos así como enfermedades. Las frutas tales como las del género Citrus, plátanos, aguacates, y fruta bomba (carica-papaya) son frecuentemente los conductores de estos inconvenientes y enfermedades.

Con el fin de mantener un servicio satisfactorio de cuarentena, es decir, un servicio que siendo eficiente, no sea a la vez una traba inconveniente para el comercio, deben conocerse los insectos dañinos y las enfermedades existentes en los países de los cuales procedan las importaciones. El éxito de un servicio de cuarentena dependerá en gran parte de la extensión de estos conocimientos.

En algunos de estos países no existe servicio alguno entomológico o patológico, sabiéndose muy poco de las enfermedades e insectos que ocurren en ellos.

En algunos de los países existen estaciones agronómicas e investigaciones sobre estos asuntos han sido realizados por varios años. En estos lugares, sin embargo, los investigadores dedican el tiempo principalmente a problemas especiales y no han publicado listas completas de las plagas y enfermedades que ocurren en sus países.

Ocurre además, que casi todos estos países que tienen estaciones agronómicas están distantemente separados y en algunos casos los habitantes de estos países hablan distintos idiomas y son de distintas nacionalidades, y las principales cosechas agrícolas son diferentes. Por estas variadas razones hay usualmente poca o ninguna cooperación en los trabajos científicos.

Es asimismo el caso de que muchas de las estaciones están pobremente equipadas de modo que el trabajo realizado es muy lento en producir resultados definitivos. Es también desgraciadamente cierto que los investigadores en las estaciones experimentales rara vez permanecen largo tiempo en un destino, y con el retiro de los mismos frecuentemente se pierden trabajos valiosos, bien por quedar incompletos, bien por no ser publicados.

Debido al presente estado de cosas, en los países panamericanos, según queda descrito, parecería que ahora es más bien una ocasión desfavorable para tratarse de cooperación sobre el servicio cuarentenario.

De hecho, y debido precisamente a estas condiciones, nace la creencia que mientras más pronto sea comenzada la cooperación, más pronto se lograría realizar algo. La cooperación debidamente realizada, debe preveer aquellas necesidades de que ahora se carece; en otros términos debe suplementar el trabajo actual de las estaciones experimentales de los departamentos de agricultura existentes.

La cooperación debe ser precursora del intercambio de listas contentivas de las plagas y enfermedades entre los diferentes países. Debe ser una ayuda material en la determinación de los insectos y plagas y aumentar la información en lo relativo a la distribución de los insectos y enfermedades y de los daños que ellos producen.

Basados en la cooperación o en los métodos de la cooperación, depende el éxito de cualquiera movimiento de esta índole. Urge, pues, que cada uno de los países panamericanos adopten servicios cuarentenarios tan pronto como

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sea practicable. Al propio tiempo se recomienda que los países, como un todo o en conjunto vayan más lejos aún. Ellos ya poseen una unión para el adelanto de las relaciones comerciales y de otros intereses comunes a todos.

Mas aún, algunos de los países sudamericanos tienen establecida ya una unión con el preciso objeto de proveer a la protección mutua contra insectos y enfermedades (12). Parecería pues que una institución que pudiera proseguir estos trabajos estuviera ya organizada. La Unión Sudamericana, con residencia oficial en Montevideo, pudiera ser engrandecida a incluir todos los países tropicales y norteamericanos o pudiera organizarse una segunda institución similar de los países tropicales y Norte América con residencia en Wáshington, bien como institución independiente o bajo la jurisdicción de la Unión Panamericana.

El trabajo pudiera proseguirse más o menos como sigue: Instituir o designar una oficina que sería un centro de información relativo a la reglamentación cuarentenaria de los diversos países; dicha oficina pudiera informar a los diferentes países de toda legislación nueva; pudiera mantener relaciones de los insectos y enfermedades dañinas ocurrentes en los diferentes países; pudiera servir como un centro para la publicación de las listas que pudieran ser recopiladas por los investigadores de los diferentes países; pudiera servir como un medio de canje por conducto del cual se pudieran hacer determinaciones de los hongos e insectos; pudiera servir como medio para el canje de información relativa a literatura sobre insectos y enfermedades, y bien pudiera llevar a cabo investigaciones especiales a la distribución de los más importantes insectos y enfermedades.

Así en muchas formas y modos, una oficina de esa naturaleza pudiera suplementar el trabajo de las existentes estaciones agronómicas y facilitaría a la vez el trabajo de las mismas; pudiendo también en cierta manera servir útilmente de auxilio beneficioso, allí donde no existen estaciones agronómicas y al hacer todo esto que señalamos facilitaría el establecimiento y mantenimiento de un servicio de cuarentena uniforme en todos los países panamericanos.

1. (*a*) Horne, W. T. The Budrot and some other Coconut Troubles in Cuba. Bul. 15. Estacion Central Agronomica de Cuba. 1908.
(*b*) Horne, M. T. The Coconut Industry in Cuba. Cuba Review, v. 11, pp. 18–20. 1907.
(*c*) Johnston, J. R. The History and Cause of the Coconut Budrot. Bul. 228, B. P. I., U. S. Dept. of Agric. 1912.
2. Fawcett, W. Report on the Caiman Islands. Bull. Bot. Dept., Jan., Feb., 1889, p. 3.
3. Budrot Disease of the Coconut Palms. West Indian Bul. VI, No. 3, 1905, pp. 307–318.
4. Stockdale, F. Coconut Palm Diseases. Proc. Agric. Soc. Trinidad and Tobago, VII, Soc. Paper 247.
5. McKenney, R. E. B. The Central American Banana Blight. Science, N. S., XXXI, No. 802, pp. 750–751. 1910.
6. Smith, E. F. A Cuban Banana Disease. Science, N. S., XXXI, No. 802, pp. 754–755. 1910.
Johnston, J. R. La Enfermedad del Plátano en Cuba. Circ. No. 47, Estacion Exp. Agronomica de Cuba. 1915.
7. Ashby, S. F. Banana Diseases in Jamaica. Bul. Dept. of Agric. II, No. 6. 1912.
8. Rorer, J. B. Bul. 65, Dept. of Agric. of Trinidad, IX, 1910, p. 157.

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9. Drost, A. W. The Surinam Disease of the Gros Michel Banana. Bul. XXVI, The Surinam Dept. of Agriculture. 1912.
10. Van Hall, C. J. J., and Drost, A. W. De Krullotenziekte der Cacao voomen in Surinam, haar oorzaak en haar bestrijding. Dept. of Agric. Surinam Bul. XVI. 1909.
11. Fawcett, G. L. Fungus Diseases of Coffee in Porto Rico. Bul. XVII, P. R. Agric. Exp. Station. 1915.
12. Véase "Le Service de Protection des Plantes dans les Divers Pays." 3rd ed. 1914. Inst. Internat. D'Agricult—Rome.

The CHAIRMAN. The formal presentation of papers will be concluded by the presentation of a paper on "Pan American cooperation in plant quarantine," by C. L. Marlatt, chairman of the United States Federal Horticultural Board. I take great pleasure in presenting Mr. Marlatt.

## PAN AMERICAN COOPERATION IN PLANT QUARANTINE.

By C. L. MARLATT,

*Chairman Federal Horticultural Board, United States Department of Agriculture.*

### GENERAL STATEMENT OF THE PROBLEM.

The staple crops of the Old World, both farm and forest, in the thousands of years of cultivation by human beings have become subject to infestation with a multitude of important insect pests and plant diseases, which now take a very large toll of the yield, and nullify to that extent the rewards of human labor. The New World was free at the time of European settlement from these many plant pests and diseases of the Old World, and, could the colonists have acted with present-day information, the introduction of the staple crops of the Old World could have been effected without the entry of many of the Old World enemies of such crops.

The danger from these plant enemies and the existence of this unique opportunity were not appreciated, and for 300 years the New World has permitted, and even aided, the entrance of insect enemies and diseases of plants from the Old World. One after another, the great crop pests of Europe, Asia, and Africa have been introduced and established on this side of the Atlantic, with a resulting damage to our agricultural and forest interests almost beyond calculation, both for the years that have already passed since the beginning of colonial settlement and also as a continuing loss indefinitely into the future.

While much of the advantage which could have been held by America by maintaining her freedom from the common farm and forest pests of the Old World has been lost, by no means all of the Old World plant pests have reached our shores, and there is, therefore, still reason and opportunity for control measures. What we want now is to recognize that all the countries of this hemisphere are one in interest as to the need of controlling the entry of Old World pests and, by the enactment of similar legislation and the building up of like bodies of experts in the countries of the New World, to make it possible for the New World as a great unit to cooperate in the regulation of the com-

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merce in plants and plant products so as to prevent the entry of additional pests and to control the further spread in these several countries or between neighboring countries of pests already locally established—in other words, Pan American cooperation in plant quarantine.

To emphasize this need, and to more fully present the problem, it may be worth while to consider in a little more detail some of the features of the subject, already broadly indicated. The illustrations and discussion presented naturally apply particularly to the conditions obtaining in the United States, but similar conditions are found in practically all the other American Republics, and equally cogent illustrations could be drawn from the experience of any of these countries.

The extent to which American agriculture could have been benefited by a properly enforced quarantine and inspection law in the past to exclude many, if not most, of the foreign insect enemies and diseases of plants may be shown by an examination of any list of the principal pests now affecting agricultural and other crops in the United States. Taking insect pests, for example, fully 50 per cent of the important injurious species now depredating on the crops of this country are of foreign origin. A few typical examples may be given to illustrate the price we are now paying for this neglect, and which we must go on paying in greater or less degree through all the years to come.

The codling moth or apple worm, introduced from Europe by the early colonists, as shown by recent careful estimates, now occasions a loss in cost of spraying trees and injury to the fruit of $16,000,000 a year.

The San Jose scale, introduced on some ornamental plants from North China and now infesting all the deciduous fruit orchards of North America, occasions a loss of product and cost of treatment of at least $10,000,000 a year.

The Hessian fly, an European wheat pest, presumably introduced with straw used for packing on the ships transporting the Hessian troops at the time of our Revolutionary War, has become the most important enemy of our wheat crop and probably causes a loss of $50,000,000 annually, and in some years this loss has reached the enormous total of $100,000,000.

The gipsy and brown-tail moths in Massachusetts and portions of other New England States are now costing these States in expenditures merely in efforts at control, not counting damage at all, upward of $1,000,000 a year. In addition to this, the Federal Government of the United States is appropriating $300,000 a year to aid in controlling these pests. In spite of these efforts and this enormous expenditure, these insects are slowly spreading and great damage is done yearly to woodlands, private grounds, and orchards. The ultimate spread of these two pests over the whole United States is extremely probable under present conditions, and will entail a like cost throughout the country—a tremendous and unnecessary charge to our fruit and forest interests.

These are merely prominent examples, but there are many others, running into hundreds, and affecting every cultivated crop.

All of the insect pests and diseases harmful to agriculture are not of Old World origin. A certain number of these are native to this hemisphere and seriously damage the distinctive crops of the New World, such as potato, tobacco, Indian corn, and our native fruit and forest trees, and are also injurious to some of the introduced Old World crops. But, even in the case of the New World crops, many of the enemies which they now have are of Old World origin, having adapted themselves to these new hosts.

It is also true that certain classes of Old World insect pests, such as the house fly and other household insects, which may be carried on ships or intro-

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duced with merchandise, have been imported and still will be in spite of any quarantine law, however rigid. It is nevertheless essentially true that the great mass of the insect enemies of the farm, orchard, and forest have come in with such farm products or with nursery and ornamental stock, and might have been kept out in large measure if quarantine and inspection methods had been in operation, even without the present-day knowledge of the more efficient means of disinfection and control.

Very careful estimates, based on crop reports and specific insect damage over a series of years, indicate that the total loss in the United States due to insect pests of farm products, including fruits, now reaches the almost inconceivable total of one billion dollars annually. More than half of this loss is properly assignable to the insect pests which have come to us from the Old World.

Important Old World plant diseases have also been introduced, along with insect pests, and are now causing loss comparable to and in some instances greater than that due to insects. The prevention of the entry of plant diseases is not always as easy as the exclusion of the insect pests. Such diseases are often not discoverable by inspection, and can not always be destroyed by fumigation or treatment, and the only safe method, where the danger is known and warrants it, is to prohibit the entry of the host plants or safeguard by growth of the introduced plants under quarantine for a sufficient period to determine freedom from disease.

Except as an incentive to taking of such remedial action as is still possible, it is useless now to dwell on what could have been saved to the agricultural and national forest resources of this hemisphere if our forefathers could have been wise enough to have early established and intelligently enforced inspection and quarantine regulations against the Old World plant diseases and insect enemies. Such action would have been conservation in its most practical form. We can, however, safeguard the future, and it is in the hope of realizing to the fullest measure this present opportunity that a Pan American quarantine is now urged—namely, such quarantine and regulatory action cooperated in by all the countries of the Western Hemisphere as shall prevent the further entry of the insect pests and plant diseases of the Old World.

Parenthetically, it may be said that, while this paper deals with plant pests and plant control, the same argument applies to the regulation and control of human and animal parasites and diseases.

While much time has been lost and much lasting damage has been done, there are still vast numbers of foreign insect pests and plant diseases with large capacity for harm which, fortunately, have not yet effected successful lodgment in any of the Americas, or have obtained only a limited foothold, and may still be subject to exclusion or to possible elimination or effective control. The increasing commerce of the world, and especially that involving any regions which have in times past been practically outside of the world's ordinary trade, as in the case of portions of China and some other oriental countries, and the long unexplored interior districts of Africa, adds enormously to the risk of importation of new pests. We know very little of the injurious insect pests of these countries, but the importation of new stock in the last few years from China especially has demonstrated the existence there of many very dangerous plant pests as illustrated by the San Jose scale, already referred to, which was one of the earliest of these Chinese insect enemies to reach us.

The Department of Agriculture has recently prepared for publication handbooks for the benefit of our inspectors and other plant quarantine officials,

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which give descriptive lists of the known insect enemies and diseases of plants likely to be introduced into the United States by commerce, or for experimental purposes, and these lists of known enemies run into thousands of species, and are yet by no means complete. The plant enemies of many regions of the world, as just indicated, are very little known, and many pests not included in these lists will undoubtedly seek entrance from such regions as China and Africa, and even from Europe and western Asia where studies of plant pests have been longest prosecuted, for new crop pests are constantly appearing in all quarters of the world.

The importance of some of these insects which we are now endeavoring, under our plant quarantine and control laws, to exclude from this country may be illustrated by a few examples. They include, among insects, the Mediterranean fruit fly, perhaps the worst fruit pest of tropical and subtropical countries, which is rapidly becoming world-wide almost in distribution; the pink bollworm of cotton, recently carried from India to Egypt and practically every other cotton-producing country of the world, except the United States, and perhaps some of the South American cotton-producing countries—an insect which can probably do more damage to cotton than the boll weevil, now our greatest cotton pest; and among diseases, the potato wart, a disease which not only destroys the tuber but infests the soil so that the growth of healthy tubers in such soil is thereafter impossible; the white pine blister rust and the citrus canker, two diseases which became locally established in the United States prior to the passage of our plant quarantine act and which heroic efforts are now being made to exterminate. One of these diseases threatens seriously the future white-pine development of America, and the other the future of our citrus crop. The entry and establishment in this country of either of the insects or diseases enumerated would mean a loss almost beyond computation, on account of the great importance of the products involved. Under our quarantine and control laws we are also excluding or controlling a considerable number of other insect pests and diseases. The exclusion of several of these dangers is of just as great importance to the South and Central American Republics as to the United States.

### THE UNITED STATES PLANT-QUARANTINE ACT.

A brief history of the plant-control legislation of the United States, its scope, and the benefits already derived from it, may be of interest. The necessity for national legislation under which the further entry of foreign insect pests and plant diseases could be prevented, and providing also for internal control, has long been recognized, and a strong continued effort was made in this country to secure such legislation, extending over a period of 15 years, beginning in 1897 and ending successfully in the enactment of the Federal plant-quarantine act of August 20, 1912.

In the absence, up to that time, of any Federal legislation, the State of California, to protect her vast fruit interests, had for 20 years or more enforced quarantine and inspection provisions in relation to plants and fruits offered for entry at San Francisco and other California ports. This action on the part of the State of California has not only resulted in untold benefit to that State, but, to a less degree, to the rest of the United States, in the protection afforded from plant enemies of trans-Pacific origin. A few of our other States have had minor plant legislation, but it was not until the early nineties that active interest in such legislation became general throughout the United States. The outbreak of the San Jose or Chinese scale in the eastern United States in the early nineties was the inciting cause of this interest, and led to local State

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legislation on the part of nearly every State of our Union. This legislation was chiefly in relation to domestic nursery stock and was designed particularly to prevent the further spread and establishment of this very dangerous scale pest.

The first general attempt to secure national legislation resulted from this same scale insect and its threatened general distribution, interstate, on nursery stock. A conference involving all the States of the Union was held in Washington in 1897, and a plant-quarantine bill was then drafted and submitted to the United States Congress. Opposition of the various interests affected led to the failure of this effort, which, however, was continued from year to year.

The discovery in 1909 of the introduction of enormous quantities of brown-tail moth nests full of hibernating larvæ on seedling nursery stock, chiefly from northern France and Belgium, led to a renewal, under the leadership of the writer, of the effort to secure legislation, and finally resulted, four years later (1912), in the enactment of the present law. Final passage of this measure was very much aided by the discovery that the Mediterranean fruit fly had become generally established in our neighboring Pacific territory of Hawaii, and was likely at any time to be carried by the traffic in Hawaiian fruits to California, and thus jeopardize the fruit interests of California and other sections of the United States.

The law of 1912, known as the Federal plant quarantine act, briefly stated, authorizes the Secretary of Agriculture, in accordance with the need, either to prohibit or to regulate the importation of nursery stock and other plants and plant products, to prevent entry of new pests; and to establish and maintain domestic quarantine districts to prevent the further spread of diseases and insect pests within the United States.

This act recognizes the peculiar Constitution of the United States Republic, and divides responsibility between the Federal Government and the State authorities. Except as to areas and plants under specific quarantine, it gives no control over the interstate or local movement of plants or plant products, nor does it give any powers under which exterminative or cleaning-up work can be done. The general interstate movement of plants not under quarantine, the local movement of plants within the State, and local control are left to the several States. It is, therefore, not necessarily in these details of internal control an act which other American countries should copy, but it does give ample and full Federal powers in its relation to the control of the entry of plants and plant products from foreign countries.

As above indicated, the control over imported plants and plant products is of two kinds—namely, control by regulation and control by prohibition.

Control by prohibition aims to exclude altogether any plants or plant products which can not easily or satisfactorily be otherwise safeguarded. Prohibitions or absolute quarantines are very simple in enforcement, and, under our system of customs control, such prohibition is administered through the cooperation of the customs office of the Treasury Department with the Department of Agriculture, with practically no difficulty or cost.

Control by regulation may apply to any of the plants and plant products which constitute the ordinary commercial trade between foreign countries and the United States. This control need be exercised only in relation to such of these plants and plant products as may require regulation to prevent the entry of known pests. The important plants and plant products now under regulation are nursery stock, potatoes, and foreign lint cotton. Any other plant or plant product can be brought under regulation should need therefor arise.

It is important that the system of control by regulation should be not only efficient but also practicable; that is, putting the least restrictions on commerce.

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Such control by regulation is effected under our act of 1912 in three ways, viz: (1) By providing for foreign certification and responsibility; (2) by a permit system, which gives full advance information; and (3) by inspection at port of entry or at final destination, with authority, in accordance with the need, either to disinfect, destroy, or reject the shipment.

The foreign certification to insure freedom from pests involves the establishment in the country concerned of a competent inspection services and fixes responsibility on a definite foreign official for the condition of the articles offered for entry. This requirement of cooperation on the part of countries desiring to maintain commercial trade in plants and plant products with the United States has led to the enactment of suitable legislation and provision for expert inspectors for the certification of goods prior to shipment by most of the countries which have hitherto maintained any considerable trade in nursery stock with the United States. Some 28 foreign countries and dependencies have thus provided by legislation for such inspection and certification. A list of these countries is here given: Australia, Barbados, Belgium, Bermuda, British Guiana, Canada, Cuba, Denmark, England, France, Germany, Guatemala. Holland, Ireland, Jamaica, Japan, Leeward Islands (Antigua, St. Christopher-Nevis, Dominica, Montserrat, Virgin Islands), Grand Duchy of Luxemburg, New Zealand, Philippine Islands, Scotland, Union of South Africa, Spain, Straits Settlements, Switzerland, Trinidad and Tobago, Wales, Windward Islands (Granada, St. Lucia, St. Vincent).

This fixing of responsibility on a definite official of the exporting country for the certification of plants has vastly improved the character of the stock offered for export to the United States. The United States is no longer a dumping ground for any sort of infested and diseased stock. Brown-tail moth and gipsy-moth infestation has practically ceased, and notable insect and disease infestation is rare. Furthermore, the general condition of the stock from the nursery standpoint has been very much improved.

The advantages of this foreign inspection and certification service, which is now, as a result of our law, world-wide, are immediately available to all other American countries.

The permit system involves the issuance of a permit to each importer for the entry of any plants or plant products under regulation. The permit regulations provide for full information in regard to the importation, including both the country and place of origin, the foreign exporter, the domestic importer, and the consignee at destination of the imported product, and also for complete system of notification of the arrival and movement of imported stock until it has finally been inspected and passed.

The reexamination of the imported plants or plant products, either at port of entry or at destination, gives a check on the foreign certification, and, as noted, is accompanied with power to exclude, disinfect, or destroy, if necessary.

This system of control—namely, fixing foreign responsibility on definite officials by the requirement of foreign examination and certification, complete information as to imported goods through the permit system, and inspection and effective control at port of entry or destination—seems to be the most practicable method of controlling and regulating the entry of plants and plant products from foreign sources to exclude new or dangerous plant pests. It has certainly worked well during the three years' trial in this country. A few of the more important insect pests and plant diseases which we are now excluding by quarantine and regulation have been mentioned elsewhere. Undoubtedly several if not all of these would now have had full lodgment in this country if this act had not been available to prevent their entry, with a resulting annual loss of many millions of dollars.

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For the information which it will give to our American republics, a complete list of the plants prohibited entry into the United States or the entry of which is regulated is given below:

LIST OF CURRENT QUARANTINE AND OTHER RESTRICTIVE ORDERS IN RELATION TO IMPORTED PLANTS AND PLANT PRODUCTS.

FOREIGN QUARANTINES.

*Potato.*—The importation of the common or Irish potato is prohibited from Newfoundland; the islands of St. Pierro and Miquelon; Great Britain, including England, Scotland, Wales, and Ireland; Germany; and Austria-Hungary, on account of the disease known as potato wart.

*Mexican fruits.*—The importation of oranges, sweet limes, grapefruit, mangoes, achras sapotes, peaches, guavas, and plums is prohibited from the Republic of Mexico on account of the Mexican fruit fly.

*Five-leafed pines, ribes, and grossularia.*—The importation from each and every country of Europe and Asia and from the Dominion of Canada and Newfoundland of all five-leafed pines, and from the Dominion of Canada and Newfoundland of all species and varieties of the genera *Ribes* and *Grossularia*, is prohibited on account of the white-pine blister rust.

*Cotton seed.*—The importation from any foreign locality and country, excepting only the locality of the Imperial Valley, in the State of Lower California, Mexico, of cotton-seed (including seed cotton) of all species and varieties and cottonseed hulls, is prohibited on account of the pink boll worm.

*Seeds of avocado or alligator pear.*—The importation from Mexico and the countries of Central America of the seeds of the avocado or alligator pear is prohibited on account of the avocado weevil.

*Sugar cane.*—The importation from all foreign countries of living canes of sugar cane, or cuttings or parts thereof, is prohibited on account of certain injurious insects and fungous diseases of the sugar cane occurring in such countries. There are no restrictions on the entry of such materials into Hawaii and Porto Rico.

*Citrus nursery stock.*—The importation from all foreign localities and countries of all citrus nursery stock, including buds, scions, and seeds, is prohibited on account of the citrus canker and other dangerous citrus diseases. The term "citrus" as used in this quarantine includes all plants belonging to the subfamily or tribe *Citrateæ*.

*European pines.*—The importation from all European countries and localities of all pines not already excluded by quarantine is prohibited on account of the European pine-shoot moth (*Evetria buoliana*).

*Indian corn or maize and related plants.*—The importation from southeastern Asia (including India, Siam, Indo-China, and China), Malayan Archipelago, Australia, New Zealand, Oceania, Philippine Islands, Formosa, Japan, and adjacent islands, in the raw or unmanufactured state, of seed and all other portions of Indian corn or maize (*Zea mays L.*), and the closely related plants, including all species of Teosinte (*Euchlæna*), Job's tears (*Coix*), *Polytoca*, *Chionachne*, and *Sclerachne*, is prohibited on account of the downy mildews and *Physoderma* diseases of Indian corn.

OTHER RESTRICTIVE ORDERS.

*Nursery stock.*—The entry of all foreign nursery stock was restricted and brought under regulation with the passage of the plant quarantine act of August 20, 1912. These restrictions cover entry under permit and provisions for foreign inspection and certification and reinspection on arrival in this country.

*Potato, avocado, and cotton.*—Under orders issued by the Secretary of Agriculture, similar restrictions now apply to all foreign potatoes, to the avocado or alligator pear from Mexico and the countries of Central America, and to all forms of raw or unmanufactured cottons from all foreign countries and localities, except the Imperial Valley in Lower California, Mexico.

Power of domestic quarantine and control of interstate movement is also given in the Federal plant quarantine act, and under this power a good many locally established pests, most of them of recent origin, are under control, and, in some instances, probably the extermination of these pests will be ultimately effected. Under these local quarantines a similar system of inspection and certification and movement under permit is provided for.

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Our neighbor on the north, the Dominion of Canada, has closely paralleled the action of the United States in legislation on the control of insect pests and plant diseases, and as a result of the same inciting causes, namely, the San Jose scale in the early nineties and the infested condition of European nursery stock in 1909 and the years immediately following. The "Destructive insect and pest act," promulgated by the Dominion Government in May, 1910, gives much the same power as does our plant-quarantine act, and in some respects, particularly in its simplicity, is preferable to the plant law of the United States.

### NECESSITY OF EXPERT ADMINISTRATORS.

The enactment of plant legislation of this kind will be of very little service to any country unless there exists in such country, or can be developed there, a trained expert force of administrators and inspectors. In the case of the United States the domestic control of injurious pests has been long fostered by important bureaus established by the National Government and by the several States, and the same is true of the Dominion of Canada and of the several Provinces included within the Dominion, so that in the case of Canada and the United States a large body of trained men were available to carry out the National and State plant laws. In the case of most of our neighboring Republics on the south a beginning has also been made in the establishment of such technical bureaus and offices, but before effective work can be done on a large scale it will be necessary for most of these countries to very much enlarge their technical and scientific personnel for this kind of work. With such adequate personnel in all of the countries in this hemisphere, cooperation in plant quarantine and regulation will be a possibility and the maximum benefit for all the countries of North and South America can be secured.

The problems involved are often common to several of our American countries, and the experts of the country most interested can be recognized as leaders in any particular investigation, the experts of other countries cooperating in proportion to the interest of the country in the subject. Such combined effort will enormously facilitate the study of special problems and hasten the discovery of control measures and make tremendously for general efficiency.

The development and present status of the entomological service in this country and the similar pathological service in relation to plant diseases will be discussed by Dr. L. O. Howard, chief entomologist of the United States Department of Agriculture, and possibly by some of the pathologists of the Department of Agriculture more particularly, as pointing out what can be done and what ought to be done in the case of the American countries south of us, as a basis for efficient plant pest cooperative control.

### RECOMMENDATIONS.

A discussion of this kind is useless unless it leads to some concrete action. It seems desirable, therefore, to formulate certain recommendations which this section and the congress as a whole can adopt. These recommendations as approved should be presented for such legislative and other action as may be necessary to the several countries concerned. Furthermore, it seems desirable that there should be some committee or commission appointed by this congress to follow up these recommendations and to use all reasonable efforts to secure the enactment of suitable laws and the establishment of competent administrative agencies.

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The provisional resolution suggested by the author as the concluding feature of this paper was revised in conference and adopted by the subsection in the following form:

Recognizing the importance of the movement undertaken as a result of the international conference to discuss agricultural defense against insect pests and plant diseases, which took place at Montevideo in 1913, with representatives of nine South American nations, the discussions at this Second Pan American Scientific Congress in Washington, 1915–16, have demostrated the desirability of extending this plant defense conference to include all American countries for the greater protection of agriculture of the Western Hemisphere as a whole, and the object of the following resolution is to provide for such Pan American conference on plant-pest control and plant introduction:

*Resolved*, That a Pan American plant protection conference be convened, the delegates to this congress to be one or more technical experts from each of the several American countries, and that as soon as practicable a meeting of this conference be held to discuss suitable legislation, the means of establishing competent scientific bureaus, and to recommend such cooperative research work and control of plant introduction as may be advisable, and to use all reasonable efforts to secure appropriate action by the several countries; and that a provisional committee be appointed from the delegates to this second Pan American Scientific Congress, Washington, 1915–16, to arrange through the Pan American Union for the appointment of delegates to such Pan American plant-protection conference and for the convening of such conference.

The following committee was nominated by the chairman of the subsection to carry out the purposes of this resolution: C. L. Marlatt, Washington; C. L. Shear, Washington; J. R. Johnston, Cuba; David Fairchild, Washington; C. D. Andrade, Ecuador; E. Carrasco Bascuñan, Chile; Roberto Sundberg, Uruguay.

This resolution as later adopted by the general conference as No. XIII, is as follows:

That an American plant-protection conference be convened, the delegates thereof to be one or more technical experts from each of the several American countries, and that as soon as practicable a meeting of this conference be held to discuss suitable legislation, the means of establishing competent scientific bureaus, and to recommend such cooperative research work and control of plant introduction as may be advisable, and to use all reasonable efforts to secure appropriate action by the several countries.

The CHAIRMAN. I do not suppose that there is any subject which has more vital bearing on the well-being of the Western Hemisphere than this subject of plant quarantine, the protection of our food supply from diseases and insect pests. With the splendid introduction which we have had from the speakers on the program and the excellent presentation of the principles being put into effect by the United States Government as given us by Mr. Marlatt I think we have the ground on which to build a very intelligent discussion. The discussion need not be specially limited, but I trust that those who take part will speak to the point which Mr. Marlatt has given us in

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these resolutions that he has presented. The question is now open for discussion.

Mr. SHEAR. I would like to say a few words as the representative of the pathologic society which has taken much interest in this subject, and which passed resolutions at its recent meeting in Columbus and has forwarded them to Congress. These resolutions are practically in harmony in all respects with the resolutions offered by Dr. Marlatt and should simply be regarded as a supplement to strengthen, if possible, the efforts which are being made in that direction.

The subject and the arguments have been so well presented that it does not seem possible to add anything more to justify the steps that have been taken. I might perhaps add a few statements from the standpoint of plant parasites, of fungus diseases especially. The subject of the difficulties in regard to control and prevention of the spread of insects has already been very ably presented by Dr. Howard and Mr. Marlatt. The difficulties in the case of plant diseases are much greater than in the case of insects. Many of our plant diseases are of such a nature that they can not be easily discovered or distinguished by inspection of the plants. Our knowledge of their origin, spread, and distribution, of their life histories in fact, is such that it is very essential that the subject be taken up and given thorough investigation from the standpoint of fungus diseases as well as of inspection. We must know as the basis for action of any kind looking toward prevention and control of these diseases, what diseases are threatening us. This knowledge we have not at the present time. Every time there is a new list of parasitic fungi published from different parts of the world you will see new organisms described on grape vines, apples, and other plants of great economic importance. We have no means of telling what these organisms may do when they are introduced into a new country and on new hosts. We have, however, some slight basis for judging of the possibilities, as shown by two recent instances which are already in the public eye—the chestnut blight disease and the citrus canker in Florida. It seems to me we have every reason to believe that there are numerous organisms of equally destructive capacity which are merely waiting an opportunity to enter America.

I would like to emphasize therefore the necessity of organizing all of our agencies and of increasing our knowledge of the actual existence and distribution of plant parasites to which we may be exposed. And it should be, as is pointed out in these resolutions, the important duty of any permanent organization, to have plant disease surveys made of the different countries and to arrange for the interchange of plant pathologists between different countries, and the

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most active and hearty cooperation between all people who are interested in the subject.

Mr. COBB. It seems to me that the resolutions should contain some clause or remark which will state that the economic losses that we have sustained are simply stupendous. From more or less close touch with several countries in which laws of this sort have been passed, I have noticed further that the education of the people on the subject, which finally resulted in the passage of the law, came largely from the discussion of the legislators on the laws themselves. It is of very little use to try to pass laws which are not supported by public opinion. Would it be posible, then, to include in the resolutions at some point reference to education of the people? My idea is that it is important that an educational system or an educational influence be brought to work in all the American countries with regard to this subject, so that the education of the people shall proceed as rapidly as possible along these lines.

Mr. COOK. I believe that Dr. Cobb's suggestion is a very valuable one in securing any action, and especially in making action effective. The resolutions have incorporated a most instructive and valuable feature—namely, the declaration of the fact that expert knowledge and expert skill are necessary to the application, to the practical use of the suggestion. That is a very honest, a very practical and important feature. I would go just one step farther than Dr. Cobb in this matter and show not only the enormous losses referred to in the subject itself, but, if possible, by means of a printed circular presented to the countries concerned, would make a very brief statement concerning the existence of these diseases and the losses that they have occasioned, because as a matter of fact these things will have to come before the people before they will understand them and demand a remedy. These are applications of a highly developed science that has not yet become established, either in this country or abroad.

The CHAIRMAN. Of course, you will all recognize the analogy between the thought that is running in the minds of the speakers and the movement for the eradication of the yellow-fever mosquito, which required an enormous amount of educational propaganda before it was seriously taken up. Those of you who will be at the general meeting which occurs on Saturday will hear a most remarkable resolution which was passed by the Section on Public Health and Hygiene—a resolution which would have been absolutely out of the question even 10 years ago in a meeting such as this, and which would have been unthinkable 20 years ago.

Mr. SWINGLE. Inasmuch as the Latin-American countries are receiving from the Old World nursery shipments and are not them-

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selves exporting large quantities, the problem is simplified. These other American countries have been touched further more or less acutely by the public-health service, and I believe that this precedent, properly handled through diplomatic channels, will greatly simplify the problem of securing adequate legislation and cooperation.

Mr. MARLATT. I want to say, Mr. Chairman, that these resolutions, which necessarily must be presented in brief form for the adoption by this subsection and by the congress, when published and transmitted to these several countries would be simply in the nature of an argument. The paper which I have read was to give them a proper background, to present the problem as a whole, indicating the fact of the existence of these pests and the losses which they have occasioned, the need of exclusion and control, and let that all go out together as an argument, as material which can be used in these countries to get legislative action.

Mr. COOK. The real point has not yet come out in regard to these matters. The difficulty is not so much in getting legislation on this point, in getting the different countries to agree upon the general desirability of the feature, which can be carried through more or less by the scientific world, but to get the people sufficiently interested and sufficiently appreciative so that this inspection service, this definite national service, will be maintained. It seems to me from that standpoint that the bringing up of this matter is very important. I think it is not only important to secure legislation but to bring the public forward to a realization of its advantages, so that this legislation will not only be enacted but properly supported in the future.

Mr. FAIRCHILD. The idea of the committee was that the subcommittee which will probably be designated by the executive committee of the Pan American Congress, would take into consideration just these very matters. Publicity and work through the Pan American Union would assist in the spread of this educational campaign, which would lead not only to laws which might be cooperative, laws which might establish the negative side of plant introduction, but would also assist in the establishment of organizations in these countries which would not only take up the study of plant parasites, but encourage the exchange of plants. You will notice in these resolutions that these organizations are going to take care of plant introduction, which to my mind is as important a factor as the negative feature of shutting out diseased plants. It would be unsafe, I think you all will admit, to shut the door to the introduction of all these plants into these countries.



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It is perfectly conceivable that the development of this plant quarantine in these South American countries would be a very one-sided affair, allowing nothing to come in, not even plants which they really ought to have in those countries, and not permitting the building up a constructive quarantine system. We ought to be extremely practical in building up a constructive quarantine policy. A constructive policy of disinfection and quarantine is already being built up in the United States so that in time we will be able to bring in anything from any country, rid it from these pests, and send it out without any fear of introducing plant parasites.

It seems to me, in conclusion, that it is going to take a lot of constructive committee work and that the calling of a congress of really scientific men from these different Latin-American countries would be a big step leading to such a result.

Mr. CARLTON. In connection with the matter of emphasizing the destructiveness of the different pests it would seem to be fully as important, if not more important, to mention what might be prevented as suggested by Mr. Marlatt in his mention of the pink bollworm. That would be a very destructive pest if allowed to come into the country and I have in mind now a very good example in my own work of the destructive yellow rust on wheat. I dislike to speak of that because I feel some personal responsibility. Possibly we could have prevented the introduction of that pest into this country. Without doubt it is the most destructive pest in northern Europe, perhaps over all of Europe, and we all know the great amount of damage it does to grain, particularly to wheat. Now this rust until lately was not known anywhere in the Western Hemisphere, and it does not now so far as we know occur south of Mexico. So we have right there a very striking example of what could be done in South America by cooperation between South American countries.

The CHAIRMAN. That point is one that I think we must keep thoroughly in mind, since this is a Pan American matter. We are not simply trying to protect ourselves against plant and animal diseases that may come to us from the southern part of the Western Hemisphere, but we are trying to protect them against such diseases as we may unfortunately have in our own country.

Mr. SWINGLE. I simply wish to suggest that in the case of yellow rust and things of that kind if the South American countries do not have it we can assist them very much in keeping it out.

Mr. FAIRCHILD. Allow me to mention in this connection and to emphasize what the presence of one of these diseases means, that I have just received in my office some photographs of infected corn. Mr. Swingle knows something about this, having looked into the matter in the Philippines. I think those of you who are interested

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will be surprised to learn of the presence of a new destructive parasite in the cornfields of Java. These are most striking pictures it seems to me of a disease which is capable of doing a tremendous amount of damage. This belongs to the class of parasites called Peronosporas, although it is declared that this is not the same disease that was found in India. If Mr. Swingle has anything to say about it I am sure we will all be interested to hear what he has to say in connection with these very remarkable pictures.

Mr. SWINGLE. I happened to see this disease, or one very like it, in the Philippine Islands, and I was told it frequently destroyed all crops in the fields. I made counts ranging from 75 to 80 per cent of plants destroyed. The disease was still making advances and may have destroyed 90 or 95 per cent. It seemed to start under conditions very like what we call good corn weather, so I think the disease could easily spread under favorable conditions to the cornfields in South America.

There could easily be prepared by a competent committee a list of 8 or 10 diseases which we do not have in the New World, or do not have in South America, which would furnish a very satisfactory basis for the education of the public. This would be very useful because the people of South America are interested as much as our own people are.

Mr. MARLATT. In preparing a document which might be sent out by this subcommittee, supposing this provisional committee is appointed, it seems to me it would be exceedingly desirable to supplement a paper like this or some new paper with such a statement as Mr. Swingle mentioned, relating to plant diseases and insect pests, mentioning perhaps 10 or a dozen which are of large importance, paramount importance perhaps. Here is a disease apparently which might almost put our corn crop out of existence or largely reduce it; and corn, as you know, is the big agricultural crop of America.

Mr. LYMAN. There is one feature in connection with the present status of the discussion which I think we must keep in mind in the matter of education of the public—namely, that every one of these diseases is of great economic importance to us during the time that their economic importance was not recognized. Secondly, the man who is not raising corn is nevertheless interested in corn disease; the man who is not raising citrus fruits is interested in the eradication of citrus canker; and the man who is not raising cotton is interested in the pink bollworm. He may think this is a matter which does not concern him, but the subject is one in which all are vitally interested.

I have been profoundly impressed during the time that I have been connected with the Federal Horticultural Board with the fact

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that very few plants are free from disease and insect pests. The casual observer and even the horticulturist may say that an ordinary plant looks pretty clean, and perhaps is clean, but when you sit down before the table, as we do, and go over every plant in detail, put it under the lens, you will find in many cases diseases present. These diseases may not be important at present. They may be unknown if the plant has come from remote regions of the earth, but as I say, one of these diseases or insects is of great potential importance when introduced into a new locality. It seems to me, therefore, that if that fact is emphasized before the public in this matter of education, together with the fact that there are many diseases known to be very destructive, it will go a long way in creating sentiment in favor of this legislation.

Mr. METCALF. Mr. Chairman, there was one point brought out in the resolution suggested by Dr. Shear that I think should be even further emphasized, and that is the matter of exchange of pathologists, or at least of pathologic surveys. The reason we know about this corn disease that has just been spoken of is that Dr. Swingle has been where he could see it. In the work of the office of which I have charge we have to examine a vast amount of ornamental trees and shrubs, particularly from Japan. The diseases that appear on them are almost wholly unknown, I think. We work from the specimens that are caught at ports of entry by inspectors.

Now, there is nothing in relation to the further introduction of diseases from Japan and the Orient that is so necessary as a survey of the serious diseases of that country. The chestnut blight has been mentioned. It became apparent eight years ago that that disease was an imported disease, probably imported from the Orient, but careful inspection of Japanese lists failed to reveal it. Yet when Mr. Meyer finally went to Japan, he told me that within 10 minutes of the time he saw his first tree he found the disease, and he firmly thinks it has spread wherever the chestnut tree is found. Now, the reason that more foreign surveys are not made is simply because public opinion is not developed to the point where the public will desire it. There is nothing more necessary, and if anything can be done in framing these resolutions to further that movement, it certainly should be done.

Mr. COBB. That is exactly the point, Mr. Chairman. The resolutions cover the ground well, and they are so short that the inclusion of two or three clauses might perhaps fully cover the ground mentioned by the various speakers in such a way that the resolutions would not be unduly long. It seems to me it might be included by making it three or four lines longer.

The CHAIRMAN. Is there further discussion?

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Mr. SWINGLE. I think there has been some misunderstanding about chestnut blight in Japan. Many pathologists have spoken to me about it. They knew Dr. Shear had found one or two similar diseases. One or two specimens which had been shown Dr. Shear were pronounced by him not to be chestnut blight. Confusion might easily be explained by the lack of material of chestnut blight to compare with it.

I want to say that the Japanese Government has an almost model service. Their service is well worth consideration by any committee which might be formed, and I think mutual discussion of affairs by our Pan American Governments is just the thing that will lead to the correction of public sentiment which will bring about the enactment of these laws. This interchange of pathologists and of material will come about naturally as a necessary consequence of conducting this work along proper lines. I believe we are at the rising tide of the movement which will soon embrace all the progressive, civilized countries of the world. I am sorry to say I do not include the European countries in this list now. There are so many conflicting influences in Europe that adequate plant protection is almost impossible at the present time.

The CHAIRMAN. Is there any further discussion? We have plenty of time to discuss this matter thoroughly.

Mr. MARLATT. With this encouragement I rise again. I simply wish to say that I think the discussion has been very useful and that the points brought out can be taken care of in these resolutions. It seems to me that the resolutions as they are could be amended or changed in a very few words to bring out the ideas. Practically all countries concerned have already passed legislation on the subject and are thoroughly acquainted with what those words mean, so it will not be necessary to go into an argument in the resolution itself to emphasize it, but I think it can be stated perhaps a little more strongly than it is. Naturally, all those suggestions which have been made will have a value to the subcommittee or preliminary committee which will necessarily have to take charge of the propaganda.

The CHAIRMAN. Do I understand that you make that as a motion, Mr. Marlatt?

Mr. MARLATT. I move, Mr. Chairman, that these resolutions be adopted by this subsection and referred to a special committee, to be appointed by the Chair, for minor revision prior to presentation for adoption to the general section.

The motion was seconded.

The CHAIRMAN. It has been moved and seconded that these resolutions be adopted and referred to a committee to be appointed by the

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Chair, subject to minor revision before being presented to the full section meeting. Are there any remarks?

After a short discussion the motion was carried.

The CHAIRMAN. The motion is unanimously carried, and the resolutions adopted. As provided, the Chair will appoint the following committee: Mr. C. L. Marlatt, of the United States Horticultural Board, chairman; Mr. John R. Johnston, agricultural experiment station, Santiago de las Vegas, Cuba; Mr. C. L. Shear, United States Bureau of Plant Industry; Mr. David Fairchild, United States Bureau of Plant Industry; Mr. Roberto Sundberg, director de La Defensa Agrícola, Montevideo, Uruguay.

At 12 o'clock noon the meeting adjourned.

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## SESSION OF SUBSECTION 7 OF SECTION III.[1]

RALEIGH HOTEL,
*Wednesday morning, January 5, 1916.*

Chairman, CHARLES J. BRAND.

GENERAL TOPIC:

**Pan American Theme: "The Effect of the Panama Canal Upon the Distribution of Farm Products.**

The session was called to order at 9.30 o'clock by the chairman.

Papers presented:

The effect of the opening of the Panama Canal upon the traffic in agricultural products, by Eduardo Carrasco B.

The effective use of the Panama Canal in the distribution of products, by Charles J. Brand.

## EFECTOS DE LA APERTURA DEL CANAL DE PANAMÁ, SOBRE LA DISTRIBUCIÓN DE PRODUCTOS AGRÍCOLAS.

Por EDUARDO CARRASCO BASCUÑÁN,

*Ex-jefe del Departamento Comercial del Ministerio de Relaciones Exteriores de Chile.*

Entiendo que dada la amplitud de la materia propuesta, debo limitarme a considerar el posible desarrollo futuro del comercio de productos agrícolas chilenos, hacia los mercados de Centro y Norte América, principalmente estimulado por la relativa proximidad a ellos en que nos ha colocado el Canal de Panamá. Trataré este tema en líneas generales.

Para que se produzca esa exportación en cierta escala, se necesitaría la existencia de tres factores, que trataré de analizar: (a) Mercado para nuestros productos en aquellos países; (b) facilidades de su acarreo; y (c) nuestra capacidad o habilidad para producirlos. Lógicamente debería hablar primero de la producción, después de su acarreo, y por fin de su consumo. Los tres factores son correlativos, y de tal manera interdependientes, que fallando cualquiera de ellos, no habrá comercio, como prácticamente hasta aquí, no lo ha habido. Cualquiera de ellos es de tal suerte esencial, que influenciándose mutuamente, han faltado al mismo tiempo, los tres.

Uno de los motivos por que en Chile no se produce más, es porque no hay suficiente mercado, o demanda del producto, ni medios de transportarlo. No hay mercado en realidad porque el producto no es ofrecido en la cantidad, calidad, presentación, y precio requeridos, y finalmente, no ha habido medios de

[1] There was no stenographic report of this meeting.



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transporte convenientes para los productos agrícolas, porque no ha habido suficientes productos que acarrear, ni posibilidad de hacer un tráfico rápido y económico.

El Canal de Panamá está destinado a romper este círculo vicioso. La nueva vía, haciendo ahorrar tiempo y dinero, hará económicamente posible el comercio de una cantidad de artículos agrícolas estimulando, en consecuencia, por un lado la demanda y por otro su producción. Ahora para estimar la posibilidad de que esa demanda se cree o el mercado se abra, especialmente en los países o regiones, que estarán sobre la ruta de las líneas de vapores que traficaran entre Valparaíso y Nueva York, hay que considerar en que consisten los artículos agrícolas chilenos, y en que circunstancias pueden llegar al mercado consumidor.

Chile es un país que ocupa justamente casi toda la zona templada del Continente Occidental Sudamericano. Es sabido que la corriente de Humboldt refresca la costa de ese país de un extremo a otro, alejándose al interior del océano, sólo a unos diez grados más al oeste de Chile. Humboldt descubrió la corriente o la determinó, y por esto lleva su nombre. Este baño de frescura ha determinado el clima templado de que gozamos, único tal vez, en todo el continente centro y sudamericano y ha determinado también la naturaleza de nuestros productos agrícolas, que son los propios de las zonas templadas y en buena parte únicos también, en Centro y Sud América.

Por la misma razón de clima, no producimos en Chile cacao, café, bananos, vainilla y demás productos tropicales bien conocidos en Estados Unidos. Sin embargo, en la región del extremo norte, en los terrenos susceptibles de irrigación, podríamos cultivar la caña de azúcar, el algodón y otros productos de este género. Para saber, pues, lo que la tierra chilena produce, o es capaz de exportar, no habría más que recorrer la lista de los artículos agrícolas producidos en California, a contar desde la frontera mexicana, hasta la de Canadá, incluyendo los Estados de Wáshington y Oregon.

La región de los Ángeles y del sur de California, la de las naranjas Valencia, se reproduce en la región norte de Chile entre los grados 19 y 30 de latitud; los valles de San Joaquín y Sacramento tienen su gemelo en el gran valle central de Chile y sus ramales entre los grados 30 y 38, y por fin el norte de California y Oregon, la tierra de los bosques, de las manzanas y peras, y de las papas, se vuelve a encontrar entre los grados 38 y 48 de latitud sur en Chile.

Siendo parientes tan próximos, en situación geográfica, clima y productos, es ya tiempo que nuestros amigos de California dejen de ignorarnos y piensen en interesarse, para completar el parecido que nos dió la naturaleza, en ayudarnos a hacer de Chile una copia completa de su maravilloso Estado, introduciendo allí sus métodos de trabajo y perfeccionados sistemas de cultivo. El californiano debería considerar que si busca el mercado europeo tanto le dará dedicarse a la agricultura en California como en Chile, porque ambos países están o estarán económica y geográficamente a igual distancia de Londres o de Hamburgo.

No está de más recordar en esta ocasión que el año 1849, muchos chilenos fueron a California, y la surtieron de víveres y semillas. Es seguro que algunas de las especies frutales o cereales que se cultivan todavía ahí, vinieron entonces de Chile habiéndose perdido el origen de su procedencia, salva respecto a los muy conocidos Chile pepper y Chile beans.

En nuestro país, se produce, pues, toda clase de frutas, a excepción de las tropicales indicadas, y gracias a una favorable combinación de clima y fertilidad de suelos, esas frutas, como en general todos los productos de la tierra,

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son de exuberante calidad y sin desear hacer comparaciones, iguales a las mejores del mundo. Puede decirse aun, que las especies importadas a Chile ganan allí en calidad y sobrepasan a las de su origen. Por esta razón el producto chileno está destinado a ser apreciado en todos los mercados, una vez que se le conozca y que seâmos capaces de enviarlo cuidadosamente preparado y embalado y a precio razonable.

Los productos secos podrán venir naturalmente en toda época, y tales serían, por ejemplo, los granos en general, entre los cuales la cebada cervecera, la avena, los frijoles, las lentejas, las arvejas y otros productos, como nueces, duraznos secos, pasas, miel, cera, etc., que son ya muy apreciados en el mercado europeo y en la Argentina, a donde va por ahora nuestra escasa sobreproducción.

Podría presentarse una larga lista de productos frescos o de estación que podrán tener acogida en los mercados de Centro y Norte América, una vez que haya las facilidades de transporte necesarias. Estos tendrían la particularidad de llegar a estos mercados en los meses en que ningún otro país del hemisferio norte y muy pocos del hemisferio sur, los producen. En efecto, nuestra temporada de cosechas es, para la naranja, avocator pear, la chirimoya u otros, de agosto a septiembre, para las frutillas, las guindas, los higos, nueces, y productos de chacarería, de octubre a abril; para los duraznos, damascos, uvas, melones, etc., de enero a abril, y para las manzanas, peras, frijoles, lentejas, papas y cebollas tardías, etc., de febrero a mayo.

En consecuencia, cualesquiera de estos productos que pudiéramos mandar en esa época a estos mercados de Centro y Norte América, llegarían en el tiempo de la mayor escasez y mayor precio de los mismos. Aun respecto de algunos de ellos la prueba está hecha, y con éxito, y no hay motivo para creer que el consumidor de esta parte de América no ha de darle también buena acogida a muchos otros, siempre que como he dicho, lleguen a precios razonables, sean de clase superior y vengan bien embalados y presentados. Y esto me lleva naturalmente a considerar los otros dos factores que son indispensables, para que semejante comercio se produzca; uno es la existencia del flete económico y apropiado, y el otro nuestra capacidad de producción.

Al hablar de fletes deberé referirme a una situación hipotética que existiría ahora mismo si no hubiera guerra, y debería agregar, derrumbes en el canal. Difícil es predecir cuántos años pasarán aun después de concluída la guerra, para que se establezca el considerable tráfico en competencia que estaba pronto a establecerse. A lo menos doce compañías de vapores estaban preparándose para iniciar su carrera entre Valparaíso, y los puertos de este hemisferio a través del canal.

De entre ellas podremos contar como las más seguras, la Pacific Steam Navigation Co., inglesa; la Compañía Sudamericana de Vapores, chilena; la Merchants' Line, la Pacific & Atlantic Line, norteamericanas; la Johnson Line, danesa, y según sea la suerte de la guerra, y sus consecuencias, la Kosmos, la Hamburg Amerika, alemanas; la Austro-Americana, austriaca; y en fin, otra italiana y otro belgo-holandesa. El Canal de Panamá iba pues a resolver de un golpe el problema de fletes entre la Costa Occidental de Sud América y los países americanos al norte de Chile.

Una vez que las cosas se normalicen no dudo que tendremos vapores rápidos y preparados para acarrear nuestros distintos productos agrícolas a estos mercados a fletes razonables, porque si las diversas compañías de vapores no nos lo ofrecen, el Gobierno de Chile se los procurará adoptando la política comercial que en estos últimos tiempos le ha estado constantemente siendo solicitada por la opinión pública de mi país.

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La compañía que estará naturalmente más interesada en acarrear nuestros productos será la chilena que he mencionado, la cual está esperando solo que el Gobierno Chileno, adopte ciertas medidas respecto al comercio de cabotaje nacional, que no dudo serán adoptadas pronto, para ordenar la construcción de cuatro nuevos barcos de 7,000 y 10,000 toneladas que llegarán precisamente a New York y en 14 días, en vez de los 20 que dura hoy el viaje. Esta compañía tiene en caja el dinero suficiente para actuar en cualquier momento.

Habida la abundancia de fletes postergada ahora por la guerra, el agricultor chileno se verá naturalmente estimulado a aumentar su producción. Mientras más bajo, más regular y apropiado sea el flete, más barato puede llegar el producto a estos mercados, más fácil colocación encontrará y aumentará en proporción su demanda, la que servirá a su turno de espuela para el agricultor chileno.

Esto me lleva a considerar el tercer factor cuya existencia es necesaria, para que la apertura del Canal de Panamá produzca algún efecto en la distribución de los productos agrícolas, y por lo que respecta a Chile por lo menos. Y este tercer factor, es el estado de la agricultura chilena y la capacidad del agricultor o de esa agricultura para producir artículos de consumo corriente en estos mercados, de primera calidad, en cantidad apreciable y constante y de preparación y presentación perfectas. Es decir, es la existencia del artículo mismo.

Para examinar este punto necesito hacer ver cuál es el estado actual y el posible desarrollo futuro de la agricultura en Chile.

Estrechado por la carencia de mercados y la carestía de los fletes, el agricultor chileno se ha limitado en general a producir escasamente para el consumo local. Digo en general, tomando en cuenta que en el comercio de productos de la tierra, hemos importado por muchos años, alrededor de 10 millones de dólares más de lo que hemos exportado de los mismos, y que por otra parte hemos sido constantes exportadores de ciertos artículos agrícolas.

Ahora, oprimidos por aquellas circunstancias, agricultores y hombres de gobierno, han estado creyendo en Chile, que la Providencia nos tenía destinados a no salir jamás de semejante situación. ¿Con qué objeto producir más y mejor si no hay compradores para nuestro producto, ni buques en qué acarrearlos? Para qué preocuparse en organizar la agricultura chilena pobre y sin horizontes? ¿Para qué establecer un Ministerio de Agricultura que procure y dirija esa organización? ¿No tenemos bastante con el salitre y el cobre? Duele confesarlo; pero Chile no ha cometido nunca un pecado mayor que el haber desatendido su más constante y generosa fuente de riqueza.

La falta de mercados y de fletes no han sido sino inconvenientes imaginarios de hecho, porque nos han sobrado recursos antes para procurarnos de una manera o de otra los fletes económicos hacia Europa y el Atlántico, y con mediana diligencia, habríamos abierto nuevos mercados o ensanchado al menos los existentes. Aun sin el Canal de Panamá que sólo ahora nos abre nuevos horizontes, nosotros podríamos, si hubiéramos procedido sabiamente, haber estado exportando a las costas del Atlántico Sudamericano, y a Europa cincuenta o cien millones de dólares de productos agrícolas al año, y digo esto con más confianza ahora que he estado observando el producto agrícola de Estados Unidos y el que viene aquí de todos los países de la tierra.

"Si se dedicaran siquiera a producir frijoles," decía Mr. Koebel en su último libro sobre Chile, "podrían exportar de ellos por valor de muchos millones." Y tal vez tuviera razón ese autor inglés, porque el frijol chileno es tal vez el mejor del mundo, y siendo este uno de los más fuertes alimentos, después de la carne, el mundo consumiría todos nuestros frijoles.

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Tal vez no es muy conocido el hecho de que la papa es originaria, de Chile; así por lo menos lo asegura Darwin. Otros han dicho que el descubrimiento de la papa ha permitido un aumento de 200 millones en la población del mundo. Sea de esto lo que fuere, el hecho es que en Chile, aunque muy frecuentemente se obtienen cosechas de ese tubérculo, por un valor dos o tres veces mayor que el de la tierra en que se ha cultivado, ha habido ocasiones en que hemos importado papas de Alemania. Producimos las frutas más deliciosas del mundo, pero hasta la fecha no sabemos como preservarlas de las enfermedades ni como empaquetarlas ni cómo ni dónde venderlas.

No hay tierra en Sud América igual a la del Sur de Chile para la industria del cerdo y de la lechería. Sin embargo, importamos jamones y tocino de California y leche condensada y quesos de Europa. En Chile está también el paraíso de las gallinas y sin embargo los huevos valen allí a veces más que en Nueva York. Producimos los mejores vinos de toda América, pero por desgracia los consumimos nosotros mismos por falta de compradores que no hemos querido o no hemos sabido buscar. Hace cincuenta años surtíamos de harina a California, Perú y Argentina. Hoy la estamos importando por valor de un millón de libras esterlinas.

Ahora ¿cuál es la causa de tan extraño estado de cosas y cómo remediarlo?

En nuestro caso, en Chile, ocurre que poseemos buena y abundante tierra, inmejorable clima, agua en abundancia en nuestras cordilleras, buena materia prima de agricultor, productos exquisitos y, en fin, mercado interior, y no lejanos ni difíciles mercados exteriores, y sin embargo, no producimos lo bastante para nuestro propio consumo. Denuncio este hecho porque lo considero científicamente interesante para los hombres de estudio, y porque creo que haga más bien a mi país, que en otras cosas ha ido a la cabeza de la civilización sudamericana, si declaro con franqueza nuestra situación, justamente con el interés de procurarle un pronto remedio.

La verdad es que no hemos dado a la producción y a su comercio la importancia debida. He dicho que hasta ahora hemos tenido de hecho abierto el mercado de Europa y del Atlántico, y habríamos podido obtener el flete económico hacia esos mercados con un sacrificio relativamente pequeño. Como el flete alto ha limitado la exportación, hemos producido poco y por lo tanto caro. Mediante esta situación y la falta de adopción de los modernos métodos de producción y de comercio, la mayor parte del fruto del agricultor se ha despilfarrado inútilmente y se lo ha llevado el intermediario y el flete. Las organizaciones de ventas nos son casi desconocidas, porque tenemos poco espíritu de asociación. Algunas veces nuestros productos se han desacreditado en el extranjero por su mala preparación o envase, cosa que podría evitar el control del Gobierno antes de que el artículo sea embarcado. Nos falta, por encima de todo, la entidad en el Gobierno, que en los Estados Unidos se llama Departamento de Agricultura que ilustra, dirige al agricultor y busca nuevos horizontes a la Agricultura, y nos falta el Departamento del Comercio, que se ocupa allá en enseñar a comerciar el producto y en buscarle nuevo mercado.

Creo y espero que uno de los más inmediatos efectos de la apertura del Canal de Panamá pueda llegar a ser justamente, en lo que hace a Chile, estimular la creación misma del producto, abriendo nuevos horizontes, no sólo al producto mismo, sino, antes que todo, a los hombres de una y otra sección del Continente Americano, los principales factores de producción. Los norteamericanos verán lo que allá nos falta y las espléndidas oportunidades que les podemos ofrecer en los países del otro lado del canal para la aplicación de sus magníficas condiciones de organización, de trabajo, para sus maquinarias y sus

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métodos; los de allá nos habremos aproximado lo bastante para venir a aprender aquí, cómo este pueblo está desarrollando la agricultura a su más alto grado de perfección y cómo, en medio de la agitación de su vida industrial y comercial, no pierde de vista la profunda máxima del fundador de esta gran República, "La agricultura es la más sana y la más noble ocupación del hombre."

Resumiendo lo dicho, para que la apertura del Canal de Panamá tenga algún objeto para nosotros en lo que se relaciona con los productos agrícolas, es necesario que coincidan tres circunstancias, que hay que crear: que nuestros primos de este lado del canal consuman nuestros productos, que haya fletes razonables para ellos, y que nosotros los produzcamos en calidad, precio y cantidad convenientes. Lo primero estaría en parte en manos de los norteamericanos; lo segundo, quedaría entregado a la competencia libre o al esfuerzo de los Gobiernos, y lo tercero debería correr de cuenta nuestra; pero las tres cosas son realizables. Se acaba de iniciar en mi país un nuevo Gobierno que trae por bandera la organización de la agricultura nacional y el estímulo a la producción agrícola y a su exportación.

Espero que esta vez sea esto una realidad. Mientras más produzcamos y más nos compren en el mercado de Norte América, más dinero tendremos con que comprar a nuestro turno sus productos y más útil habrá sido para todos la apertura del Canal de Panamá.

Cambiaremos por la misma vía nuestros diversos productos agrícolas. Nosotros somos compradores de toda clase de productos tropicales, y en épocas de escasez, en nuestro invierno, de muchos de los productos de los Estados Unidos, que entonces están en el tiempo de la abundancia.

La exportación de los productos agrícolas de este país a Chile irritará hasta cierto punto a nuestros agricultores, pero los estimulará a aumentar, a perfeccionar y a abaratar su producción.

Pensaremos entonces en hacer uso de los depósitos frigoríficos, que aún no los tenemos ni en los pueblos interiores, ni en los puertos, ni tampoco el carro frigorífico forma parte del material rodante de nuestros ferrocarriles. Estimularemos también a las compañías de navegación a que los establezcan en algunos de sus vapores.

Aprenderemos a criar cerdos económicamente, y en grande escala; practicaremos el arte y la ciencia de la lechería moderna; criaremos razas de alta producción; imitaremos a los hacendados de Peteluma, en California, en su habilidad en la crianza de gallinas, y a los fruteros del mismo Estado en sus perfeccionamientos en la producción, embalaje y comercio de las frutas.

La competencia de los Estados Unidos por medio del Canal de Panamá, nos obligará a progresar. Y si no lo hacemos nosotros y aunque lo hagamos, presento esta oportunidad al hacendado mismo de Estados Unidos, al capitalista y al hombre de empresa.

Chile tiene las mismas posibilidades agrícolas de California, pero su desarrollo agrícola está al nivel del que tuvo California 30 ó 40 años atrás. Chile está por vía del Canal de Panamá, más cerca que California de Europa y del Este de Estados Unidos. Valparaíso, nuestro puerto principal en la región agrícola, está de Nueva York y Liverpool 600 millas más cerca que San Francisco.

En Chile hay donde invertir trescientos millones de dólares en el desarrollo de la agricultura e industria anexas con mucho más margen de beneficio que en cualquiera parte de los Estados Unidos.

Solamente en obra de irrigación necesitamos invertir pronto sesenta millones de dólares. Necesitamos irrigar nuevas tierras para destinarlas principal-

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mente a la crianza de ganado del que somos importadores por varios millones de dólares.

Aún no hemos comenzado nosotros a subdividir las tierras. En el mismo país tenemos colonos que comprarían uno o dos millones de acres en lotes de 10 a 100 acres. La propiedad está dividida en setenta mil haciendas, al paso que la de California, con mucho menos población rural que Chile lo está en cerca de doscientas mil. Padecemos del mal del latifundio con todas sus consecuencias económicas y sociales.

He aquí otra oportunidad para el promotor y capitalista americano que sabe muy bien desarrollar el negocio de la subdivisión de la propiedad.

Otros hombres han calificado ya a la región agrícola de Chile, como la más interesante de Sud América para hacer de ella una permanente residencia. En ninguna otra, en efecto, se encuentran reunidas tantas circunstancias que hagan la vida agradable y el trabajo fructífero. Delicioso clima, tierra fértil, hermoso escenario, cerca en todas partes del mar, variedad infinita de producciones, baratura de la vida, medio civilizado y pacífico, leyes protectoras, y en fin, nada de mosquitos, serpientes, fiebres, ni otras molestias tropicales.

Termino invocando la ayuda de los Departamentos de Agricultura y Comercio de Estados Unidos en la tarea que ahora nos hemos propuesto de reorganizar la agricultura chilena. El aumento de nuestra producción exportable significa en último término limitar la carestía de la vida de los países compradores nuestros, proveyéndoles oportunamente de artículos de primera necesidad en los momentos de su carestía y escasez; significa la provisión a Estados Unidos de materias primas para sus industrias y el aumento de la riqueza general en Chile, que acrecentará nuestro poder comprador de manufacturas americanas. Estados Unidos debe interesarse en el aumento de la riqueza panamericana.

Al hablar de los efectos de la apertura del Canal de Panamá no he podido menos de entrar en estas consideraciones generales que se refieren más bien a la producción que al comercio mismo. Sin producción la palabra comercio no tiene ningún sentido. El Canal de Panamá no se ha hecho tampoco para que pasen por él los buques vacios.

## THE EFFECTIVE USE OF THE PANAMA CANAL IN THE DISTRIBUTION OF PRODUCTS.

By CHARLES J. BRAND,

*Chief, Office of Markets and Rural Organization, United States Department of Agriculture.*

Two, from our merely human standpoint, unpreventable occurrences have made impossible up to now a thorough test of the economic importance of the Panama Canal. The first of these is the European war, with all of the abnormalties of trade and commerce that it has superinduced; the second, the several slides that have occurred, due to nature's attempt to restore a physical equilibrium of the earth's crust, which have interrupted traffic for varying periods.

A comparison of canal traffic during the 12 months from October, 1914, to September, 1915, inclusive, is afforded by the tabulation given below. As a serious slide closed the canal on September 18, the figures for that month represent only a little more than a half month's business.

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| Month. | Atlantic-Pacific. | | Pacific-Atlantic. | | Total. | |
|---|---|---|---|---|---|---|
| | Vessels. | Cargo. | Vessels. | Cargo. | Vessels. | Cargo. |
| | | *Tons.* | | *Tons.* | | *Tons.* |
| October | 44 | 168,069 | 40 | 253,288 | 84 | 421,357 |
| November | 54 | 206,510 | 38 | 242,291 | 92 | 448,801 |
| December | 43 | 179,235 | 57 | 271,219 | 100 | 450,454 |
| 1915. | | | | | | |
| January | 44 | 208,082 | 54 | 240,925 | 98 | 449,007 |
| February | 39 | 150,987 | 53 | 276,078 | 92 | 427,065 |
| March | 57 | 217,447 | 80 | 417,610 | 137 | 635,057 |
| April | 59 | 237,384 | 60 | 285,457 | 119 | 522,841 |
| May | 67 | 246,534 | 75 | 332,174 | 142 | 578,708 |
| June | 83 | 320,619 | 60 | 282,561 | 143 | 603,180 |
| July | 93 | 316,773 | 77 | 388,696 | 170 | 705,469 |
| August | 89 | 249,119 | 72 | 326,218 | 161 | 575,337 |
| September | 49 | 181,380 | 51 | 274,937 | 100 | 456,317 |
| Total | 721 | 2,682,139 | 717 | 3,591,454 | 1,438 | 6,273,593 |

With only a moderate growth in cargo tonnage, when both of the present difficulties shall have become things of the past, the monthly traffic through the canal may readily reach 1,000,000 cargo tons per month. Who can tell but that in 10 years it will exceed this figure? Already during July, 1915, it exceeded 700,000 tons.

So far as it bears on commercial intercourse between North and South America, the use of the canal contemplates the transportation of products from the east coast of North America to the west coast of South America and vice versa, and from the east coast of South America to the west coast of North America and the reverse. This does not necessarily mean return cargoes direct, as the canal offers a wide range of choice in new traffic routes, which as they become organized will minimize the economic waste due to long journeys in ballast.

The possible savings in expense due to reduced mileage and shortened time are indicated sufficiently by three examples: San Francisco and New York are brought 7,873 nautical miles nearer to each other than by way of the Straits of Magellan, the difference between 13,135 and 5,262. (It is to be remembered that a nautical mile is a little more than 800 feet longer than our statute mile.) So the saving is about three times the distance from New York to San Francisco by rail. A 10-knot per hour steamship makes the trip in 22 days, as against 55 days via the Horn.

The distance saved from Iquique, one of the great Chilean ports from which the nitrates so important to our agriculture are obtained, is 4,139 miles.

The most pronounced savings are from eastern North America to western South America. San Francisco is somewhat nearer Buenos Aires via Cape Horn than by way of the canal, but Rio de Janeiro is 824 miles nearer via the canal; Pernambuco, 3,000 miles; and Para, 5,210.

How shall the latest possibilities thus expressed be mobilized? That there is ample opportunity may be illustrated by the facts regarding a single relatively minor agricultural product—prunes. According to a statement published recently the United States exported in 1913 118,000,000 pounds of prunes, valued at over $6,500,000. Only about $14,000 worth went to the whole of South America, though over a quarter of a million dollars' worth of the fruit is imported annually. The facts with reference to dried peaches and apricots are equally significant. In 1914 we shipped only $7,676 worth of the former and $9,306 worth of the latter to South America. That our Central and South American friends have in a similar measure neglected to exploit the oppor-

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tunities offered by the United States as an outlet for their surplus production is no doubt also very true.

The canal was opened on August 15, 1914. From that date to September 18, 1915, a total of 1,519 vessels, carrying 6,706,915 cargo tons, passed over the route. In order of importance the commodities that headed the list at the close of the fiscal year June 30, 1915, were nitrates, sugar, coal, refined petroleum, wheat, and barley. Three of the six are agricultural products and a fourth, nitrates, finds its greatest use in agriculture.

The volume and direction of movement of the agricultural commodities is of more than passing interest.

| | Atlantic to Pacific. | Pacific to Atlantic. | Total. | | Atlantic to Pacific. | Pacific to Atlantic. | Total. |
|---|---|---|---|---|---|---|---|
| | *Cargo ton.* | *Cargo ton.* | *Cargo ton.* | | *Cargo ton.* | *Cargo ton.* | *Cargo ton.* |
| Nitrates | 411 | 651,537 | 651,948 | Petroleum, refined | 220,229 | 32,199 | 252,428 |
| Sugar | 21,068 | 277,776 | 298,864 | Wheat | 7,533 | 222,689 | 230,222 |
| Coal | 279,064 | 7,500 | 286,564 | Barley | ..... | 204,751 | 204,751 |

Some reference to the importance of the canal in affecting distribution from the Western to the Eastern Hemisphere is warranted. Before the opening of the canal the Pacific coast's greatest outlet for grain and flour was the Orient. This business has been interfered with of late owing to the lower freight rates which it has been able to command for wheat and flour. This has tended to throw the oriental market more into the hands of Australia as a supply depot. Before the opening of the canal practically all of the grain in the far Northwest was handled in bags, but since its opening improved methods of handling grain have found their way into the trade and the use of bags gradually is being eliminated. This is a fortunate result for the farmers, as the cost of sacking has been increasing during late years and indications are that it will remain on a relatively high basis. Large quantities of barley are shipped annually from the Pacific coast to the Atlantic seaboard and Europe. Hundreds of thousands of dollars will be saved annually in freight rates on this grain. California barley is in excellent demand in European markets. In September, 1915, the rate on barley from San Francisco to New York was 45 cents per hundred pounds. The rail rate between these points was 81.8 cents per hundred pounds.

The Panama Canal has important potentialities in the movement of the apple crop of the Northwest. This rate provides through traffic facilities so that fruit can be shipped without transfer to many export centers at much less expense than in the past by rail. After sufficient time has elapsed for the development of the facilities offered by the canal, a reduction in price to eastern and European consumers should be possible. From the standpoint of the western apple crop, the canal should also facilitate the opening of markets in the Atlantic South American countries, where unusual opportunities to develop markets in American fruits and vegetables are believed to exist. In so far as the facilitation of agricultural distribution is concerned, the western coasts of the continent probably will be the chief beneficiaries.

The dried-fruit industry of our Pacific territory should benefit particularly. The principal outlet for this class of products during the past has been in Europe. During 1912 and 1913 more than one-half of the dried fruits produced were exported. The following figures show the exports for dried fruits during 1913: Germany, 49,000,000 pounds; Netherlands, 16,500,000 pounds;

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Belgium, 6,300,000 pounds; Denmark, 3,750,000 pounds; France, 12,000,000; Canada, 11,000,000; and Great Britain, 8,500,000 pounds. Our exports on dried apricots reached the amount of 16,000,000 pounds in 1911, Great Britain taking 5,000,000 pounds and Germany 3,000,000 pounds. To show the rate at which the dried-fruit industry is increasing, in 1908 California produced 145,000 tons of cured fruit; in 1912, 259,000 tons. In 1895 California produced 65,000 pounds of prunes, while in 1912 she produced 205,000,000 pounds. Inasmuch as the principal outlet for dried fruits is the European market, it can be seen that there is an excellent opportunity for opening new markets by use of the Panama Canal and in effecting a saving to consumers and a reduction in freight rates and even larger profits to the producers, which will tend to develop this industry on a larger scale than it has been enjoying in the past.

The rate from the Pacific coast to New York City on canned goods via the Panama Canal is 30 cents per hundredweight, as against 85 cents by rail. The rate on dried fruit is 40 cents, as against $1 by rail. There is a saving of one-half over the old rail and steamer rate to European points for direct shipments through the canal. To show the type of cargoes which are leaving the Pacific coast, it is noted that on August 17 a sailing vessel left San Francisco for Sweden with a cargo of 3,137,551 pounds of beans. A cargo also left for London by steamer of 44,000 pounds of apricot pits, 103,176 pounds of canned goods, 908,000 pounds of dried apricots, 16,250 pounds of peaches, 803,900 pounds of raisins, and 1,469 cases of honey. On August 21, 2,678 cases of canned goods, 999,575 pounds of dried apricots, and 903,387 pounds of dried prunes comprised a cargo which was routed for England.

The past 10 days have been filled with programs of great length and interest. Hence we are all somewhat surfeited. Therefore, I will come abruptly to a brief topical statement of the factors that must have definite attention if effective use is to be made of the canal in the distribution of both perishable and nonperishable products.

It is taken for granted that the waterway will be kept open and free from physical obstructions. What has been accomplished in the construction and operation of the canal is a marvel of efficiency. In due time the slide difficulty will be removed. We must not blame the engineers because nature works out its laws in the normal way. Then the mechanical equipment must be kept in efficient working order and there must be no unnecessary restrictions, legal or otherwise, which would cause unnecessary delays or hamper the free use of the canal.

1. The canal tolls must be kept on a reasonable basis. That this will be done is indicated by the practical, scientific way by means of which the schedule of charges established by Executive order of the President was determined. The system of tolls is simplicity itself. Loaded commercial vessels pay $1.20 per 100 cubic feet or per canal ton, plus a like amount per 100 cubic feet of deck load. The usual tonnage rate is from two to two and one-half times as great as this. Vessels in ballast pay 72 cents per 100 cubic feet.

2. The United States should take at once such steps, in keeping with the genius of American institutions, as may be found necessary to bring about the building up of an adequate merchant marine. If private enterprises feel the undertaking is too difficult, expensive, or doubtful, the Government itself should initiate the work in such manner as experts may determine to be best to accomplish the desired ends. These include enough American bottoms, and I mean both South and North American, so that we will have reasonable ocean freight rates, regular sailings, with frequent service, well-selected routings suited to particular products, and so that we will at all times be relatively independent

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of the merchant fields of other nations whose use either may be denied us on short notice or may be enjoyed only at prohibitive rates. The other countries of Pan America also may be able to take steps that will encourage and assist toward the building of an adequate merchant marine for the normal needs of the Western Hemisphere.

3. The transcontinental railroads of the United States must not be given, either by legislation or otherwise, privileges or advantages that can be used detrimentally in competition with the canal. This is said in no spirit of unfriendliness toward the railroads, whose part in the upbuilding of our countries has been indispensable. Their proper interests must be safeguarded and they should receive just treatment but not preferential treatment at the expense of the people.

4. For their mutual benefit the Pan American countries should encourage the interchange of commodities between each other in the transportation of which the canal can be used to greatest advantage. Many other factors will require attention if the effective use of the canal is to be attained. To mention only one type of activity by way of illustration there must be experimental determinations under controlled conditions of the refrigeration or ventilation requirements of different products to minimize loss during the pioneering period, efficient refrigeration and ventilation stowage must be constructed upon the vessels plying the canal, and if transfers of perishable products are involved at certain points cold storage transfer plants may be required.

With these suggestions I will close, expressing the earnest hope that inter-American trade and mutual understanding may grow to their fullest extent. The subject under consideration is a large and difficult one, worthy of far more time and greater ability than I have been able to bring to it.

Adjournment of subsection 7 of Section III.

68436—17—VOL III——59

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## SESSION OF SUBSECTION 5 OF SECTION III.[1]

BUREAU OF ANIMAL INDUSTRY,
DEPARTMENT OF AGRICULTURE,
*Thursday morning, January 6, 1916.*

Chairman, GEORGE M. ROMMELL.

GENERAL TOPIC:

**Pan American Theme: "Are Uniform Regulations Feasible Among the Different American Countries for the Prevention of the Introduction and Dissemination of Diseases of Animals? The Prevention and Eradication of Destructive Diseases of Aniamls."**

The session was called to order at 9.30 o'clock by the chairman.

Papers presented:

Convención internacional Americana de policía veterinaria, by José León Suárez.

Es factible la reglamentación uniforme entre los diferentes países Americanos para la prevención de la introducción y propagación de las enfermedades de los animales? Prevencion y extinción de las enfermedades que deizman a los animales. Papers by: Francisco Etchegoyen, Rafael Muñoz Ximínez, Julio Besnard, and A. D. Melvin.

### CONVENCIÓN INTERNACIONAL AMERICANA DE POLICÍA VETERINARIA—POSIBILIDAD DE AJUSTARLA EN DETERMINADAS CONDICIONES.

Por JOSÉ LEÓN SUÁREZ,
*Profesor de la Universidad Nacional de Buenos Aires.*

PRÓLOGO.

Este asunto fué propuesto por primera vez por mí en el Congreso Científico Internacional Americano de 1910, reunido en Buenos Aires, según puede verse en las actas respectivas (sesión del 10 de julio de 1910).

Posteriormente se hizo práctica esta idea en la Convención Internacional de Policía Veterinaria, reunida en Montevideo en mayo de 1912 y celebrada entre las Repúblicas Argentina, Brasil, Chile, Paraguay y Uruguay.

Por el interés que tiene esta Convención, que creo es la primera en su género que se haya celebrado y, desde luego, la primera en el nuevo mundo, acom-

[1] There was no stenographic report of this meeting.



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paño en forma de "apéndice" el texto de la misma, que puede servir de pauta para una semejante, extensiva a todos los países americanos.

Copiamos, también, en el apéndice, precediendo a esa convención, algunos párrafos de la exposición del ex-Ministro de Relaciones Exteriores y Culto, Dr. Ernesto Bosch, porque demuestran el concepto que ese acto mereció del Gobierno Argentino y hacen constar (sin duda, demasiado amablemente), mi participación en el mismo. (Véase la "Memoria de Relaciones Exteriores y Culto" correspondiente al año 1911–12, páginas xvii a xx.)

La cuestión de la posibilidad de establecer una "reglamentación" uniforme entre los diferentes países americanos para la prevención de la introducción y propagación de las enfermedades de los animales está pues, de hecho, positivamente resuelta por el antecedente recordado.

(Esta convención no ha entrado todavía en vigor por no haber sido ratificada por todos los contratantes, pero lo ha sido por algunos.)

La posibilidad de una reglamentación uniforme debe entenderse en un sentido relativo y preciso.

No es posible reglamentar circunstanciadamente y de una manera uniforme todas las medidas de policía sanitaria veterinaria; sólo es posible acordar aquellos principios generales y, sin embargo fundamentales, para cualquiera reglamentación eficaz que quiera establecerse, según las necesidades propias determinadas por las exigencias de lugar y tiempo. Una reglamentación uniforme e invariable es imposible absolutamente, por las siguientes razones:

1°. Los principios de la profilaxia veterinaria son esencialmente variables de acuerdo con el adelanto continuo de las investigaciones científicas, sobre la etiología de las enfermedades. De consiguiente, cualquiera convención que descendiera a los detalles, podría al poco tiempo resultar inaplicable o perjudicial.

2°. Las reglamentaciones dependen completamente de las circunstancias de los medios físicos, ganaderos y administrativos. Son estos tan variables en nuestro vasto continente americano, que sería utópico pretender una reglamentación uniforme.

En cambio pueden y deben establecerse principios generales uniformes del carácter siguiente:

1°. Será en absoluto prohibida la introducción de animales afectados de enfermedades contagiosas graves.

En materia de importación, distinguiendo entre ultramar y limítrofe, debiera organizar cada gobierno, en los lugares aparentes de sus fronteras, un servicio de policía sanitaria suficiente, con estaciones de observación donde se empleen los procedimientos experimentales que permitan afirmar un diagnóstico seguro.

2°. Prohibición de importar productos de animales, forrajes u objetos que puedan ser vehículo demostrado de enfermedades contagiosas.

3°. Establecerá cada país con precisión los requisitos que deberán llenar los certificados sanitarios del país de origen que se presenten con los animales y que contendrán, entre otras, estas circunstancias:

(*a*) Declaración del estado epizoótico del país, en lo que se refiere a enfermedades de carácter grave.

(*b*) Declaración de la no existencia en absoluto de las mismas enfermedades dentro de la jurisdicción territorial de las divisiones políticas del Estado (Provincia, Departamento, condado, etc.) durante un período inmediatamente anterior, de por lo menos tres meses.

(*c*) Ser expedido por la autoridad nacional más elevada (ministerio de agricultura o la autoridad superior que lo represente).

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4°. En materia de policía sanitaria interna es esencial que el sistema adoptado para combatir las enfermedades obedezca al principio de la unidad. Por consiguiente, los Gobiernos americanos organizarán un servicio de policía sanitaria suficiente, dependiente de una administración central, para combatir las enfermedades exóticas y las existentes que uno considere oportuno.

5°. Establecerán, precisamente, el alcance y efecto de la declaración de infección de una región o localidad.

6°. Se organizará una Oficina Central Americana encargada de recibir las informaciones y recopilar las estadísticas relativas a las epizootias, enzootias y toda clase de cuestiones relacionadas con la policía sanitaria veterinaria.

Sin perjuicio de lo que disponga la organización oficial de esta oficina, los Gobiernos se informarán recíprocamente, por el órgano y por los medios que determinen, de la aparición y existencia de toda enfermedad contagiosa, grave, aguda y de propagación rápida, cualquiera que sea su naturaleza.

7°. Obedeciendo a modalidades especiales, el tráfico de ganados entre países limítrofes, los Gobiernos respectivos reglamentarán por convenios especiales el comercio recíproco de ganado y sus productos, indicando las medidas de policía veterinaria aplicables en cada caso, según el destino de los mismos.

8°. La oficina central proyectará la reunión de una conferencia internacional americana de policía sanitaria veterinaria, con el objeto, entre otros propósitos, de organizar un laboratorio central encargado de estudiar los procedimientos más eficaces para prevenir y extirpar las epizootias más importantes existentes en las diversas especies de ganado de los países de América.

APÉNDICE.

(Párrafos de la Memoria del Ministerio de Relaciones Exteriores y Culto, correspondiente al año 1911–12 y texto de la Convención de Policía Sanitaria Veterinaria sancionada en la Conferencia Internacional de Montevideo.)

"Los delegados de la Argentina, Brasil, Chile, Paraguay y Uruguay llegaron, después de rápidas pero eficaces deliberaciones, a firmar la convención que el Poder Ejecutivo ha sometido a la ratificación de V. H.

Dicha convención sintetiza en once artículos las medidas fundamentales de policía sanitaria en la frontera, de policía sanitaria interna, entre Estados contratantes y disposiciones especiales.

Siendo improcedente establecer en una convención entre cinco Estados—y cuyo protocolo ha quedado abierto para que puedan acceder a sus proposiciones otros países sudamericanos—medidas reglamentarias, la Conferencia Internacional se concretó sabiamente a consignar aquellas disposiciones bases que deben servir de punto de partida para las reglamentaciones.

Los Gobiernos respectivos podrán dictar con toda amplitud los reglamentos de policía sanitaria para la importación de ultramar y de policía sanitaria interna para combatir las epizootias y enzootias que perjudiquen su ganadería, sin otras restricciones que las establecidas por las bases fundamentales convenidas, que se inspiran en un orden exclusivo de sanidad veterinaria.

En cuanto a las medidas especiales de policía sanitaria para regular el comercio de ganado entre Estados contratantes limítrofes, la convención ha establecido acertadamente que ellas serán reglamentadas por arreglos bilaterales en los que se tendrán en cuenta las modalidades características de este comercio.

* * * * * * *

La convención, entre otras ventajas, tiene la de no contener obligaciones condicionales para un país, en relación con determinado estado sanitario de otro u otros países.

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Esta medida previsora aleja la posibilidad de conflictos de deberes entre los Gobiernos contratantes y con otros extraños a la convención.

El Gobierno que descuide precaverse convenientemente contra la introducción de epizootias sufrirá la inmediata sanción de los perjuicios de su descuido y la subsiguiente de las medidas de resguardo que con toda libertad de acción podrán, en este caso, adoptar en defensa de su ganadería los Gobiernos de los demás países contratantes .

* * * * * * *

Esta convención, que es la primera en su género ajustada en el Nuevo Mundo, y una de las más completas que se haya hecho hasta la fecha con carácter internacional plurilateral, tendrá trascendencia en Europa, por cuanto presentará a los países de esta parte de América como entidades que, no obstante su independencia, saben reunirse en comunidad de esfuerzos cuando se trata de defender la comunidad de sus intereses.

El Ministro de Agricultura y el de Relaciones Exteriores y Culto, por lo que a cada uno le concierne, han quedado satisfechos de la actuación de la delegación argentina y de los resultados de esta convención.

* * * * * * *

La Comisión Relatora despachó sin objeción el proyecto de que es autor el delegado argentino D. José León Suárez, el que sometido a la conferencia, fué adoptado con ligeras modificaciones, quedando convertido en la Convención Sanitaria Internacional de Policía Veterinaria que dispone:

ARTÍCULO 1°. Los Gobiernos de los países contratantes convienen en organizar en los lugares de su frontera o en los que consideren oportunos, un servicio de policía veterinaria suficiente para impedir la introducción de animales afectados por enfermedades contagiosas o sospechosos de estarlo.

ART. 2° En las estaciones de observación sanitaria se emplearán todos los procedimientos experimentales que permitan afirmar un diagnóstico seguro (como tuberculina, maleina, etc.).

ART. 3°. Convienen también en prohibir la importación de productos animales, forrajes u objetos que puedan ser vehículo demostrado de enfermedades contagiosas, considerándolos como tales cuando acompañen o procedan de animales enfermos o sospechosos de estarlo.

ART. 4°. Los Gobiernos respectivos establecerán, precisamente, en sus reglamentos las medidas de desinfección de los lazaretos, buques, vagones, y lugares pertinentes, cuando se hubiera producido algún caso de peste bovina, perinuemonía contagiosa, muermo, fiebre aftosa, dourina, viruela ovina, peste porcina o de toda otra enfermedad contagiosa, grave aguda y de propagación rápida.

ART. 5°. Establecerán también la forma y requisitos de los certificados que deben presentarse, como garantía de que los animales vienen de procedencias limpias, las planillas e informaciones que presentarán los capitanes de buques que conduzcan ganado y las principales anotaciones de los registros que deberán llevarse en las inspecciones de importación.

ART. 6°. Los países contratantes organizarán un servicio de policía veterinaria suficiente y dependiente de una administración central para combatir las enfermedades exóticas y las existentes que cada uno considere oportuno. Se considerarán para este efecto, como exóticas las enumeradas en el Artículo 4°.

ART. 7°. Establecerán precisamente el alcance y efecto de la declaración de infección de una región o localidad determinada, así como lo que debe entenderse por regiones o localidades sospechosas.

Al solo efecto de las enfermedades exóticas a que se refiere el artículo anterior se considerarán infectadas las localidades donde ocurran casos repetidos

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y se considerarán sospechosas las que estén próximas o en fácil comunicación con otra infectada.

ART. 8°. Los Gobiernos de los países contratantes se informarán recíprocamente, por el órgano y los medios que determinen los respectivos reglamentos, de la aparición o existencia de toda enfermedad contagiosa, grave, aguda y de propagación rápida, cualquiera que sea su origen o su naturaleza.

ART. 9°. Los Gobiernos de los países contratantes, además de las medidas generales establecidas en los Artículos 1°, 2°, 3°, 4°, y 5° de esta convención, que crean conveniente aplicar, reglamentarán por convenios especiales el tráfico de ganados entre países limítrofes, indicando las medidas de policía veterinaria aplicables en cada caso, según el destino del mismo.

ART. 10° La convención entrará en vigor inmediatamente de ser ratificada, durará cuatro años y no siendo denunciada seis meses antes por alguna de las partes contratantes, se considerará prorrogada por igual período.

La denuncia no producirá efecto sino para la parte que la formula.

ART. 11. Queda abierto el protocolo de esta convención para que puedan acceder a sus disposiciones los otros países sudamericanos que deseen hacerlo. Para este efecto deberán comunicarse con el Gobierno de la República Oriental de Uruguay, el que hará saber la accesión a los Gobiernos de los países contratantes.

## ¿ES FACTIBLE LA REGLAMENTACIÓN UNIFORME ENTRE LOS DIFERENTES PAÍSES AMERICANOS PARA LA PREVENCIÓN DE LA INTRODUCCIÓN Y PROPAGACIÓN DE LAS ENFERMEDADES DE LOS ANIMALES?—PREVENCIÓN Y EXTINCIÓN DE LAS ENFERMEDADES QUE DIEZMAN A LOS ANIMALES.

Por FRANCISCO ETCHEGOYEN,

*Profesor de Patología Veterinaria de la Universidad de la Habana.*

La enseñanza de la medicina veterinaria, que va difundiéndose con verdad por los países americanos, ha formado ya un cuerpo de profesionistas cultos, plenamente compenetrado de su actuación en materia sanitaria, que siguiendo derroteros progresistas ha rehuído los sistemas teorizantes para fundamentarse siempre en la experimentación; y cuando ésta no responde, porque no lo permiten los actuales conocimientos médicos, entrégase a las deducciones prácticas que se derivan de la observación razonada.

Es decir, que poseyendo esos conocimientos está capacitado para desenvolverlos y obtener de ellos los mejores resultados; pero como no es posible moverse en este sentido sin contar con lo principal, hállase estancado esperando que los acontecimientos políticos y de buena administración, lleven al poder a los gobernantes de buena voluntad.

La historia de lo que ha ocurrido en Cuba lo demuestra; escasa de actuación, la persecución de las enfermedades de los animales, durante la dominación española, comienza a bosquejarse, en época de la primera intervención de la grande y generosa nación americana, en nuestros destinos, con la persecución al muermo equino, hoy casi extinguido; con la elaboración de las vacunas contra los carbuncos, fácilmente dominados; contra la obtención del suero para combatir el cólera de los cerdos que tan buenos resultados está dando desde que nos enseñó su preparación el eminente Dr. Balton, bajo los auspicios del actual

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Honorable Señor Secretario de Agricultura, lleno de iniciativas y buenos deseos que se estrellan ante lo exiguo del presupuesto. Esto es algo; pero si se tiene en cuenta que ha empezado hace diez y ocho años, y lo mucho que queda por hacer, fácilmente se deduce que a tan interesantes problemas se les presta la atención que reclaman de manera lenta e intermitente.

Los conocimientos actuales no autorizan para que confinemos la persecución de las enfermedades de los animales a reducido número de ellas. Siendo numerosas las transmisibles, y observándose que es necesario precaverse contra las no especificadas, justo es considerarlas dentro de la amplitud que imponen.

Si se tiene en cuenta que tiende la humanidad a multiplicarse más rápidamente que los medios de subsistencias, y que contribuye a producir la escasez el creciente desamor a las labores agrícolas, avivado por las seducciones de la llamada civilización, cuando no la produce el afán de llevar las energías, constancia e iniciativas hacia otras actividades erróneamente supuestas más productivas, impónese la necesidad de conservar, aumentar y mejorar la ganadería.

Mas téngase en cuenta que no ha de concurrir a esas finalidades severa reglamentación que se ocupe de perseguir las enfermedades solamente en el momento de la importación. La aplicación de esta medida de repulsión será siempre egoísta y antieconómica.

A primera vista parecen excelentes cuidados sanitarios y buen resguardo de la riqueza pecuaria nacional, los cordones sanitarios fronterizos, las cuarentenas en los puertos y hasta la devolución al país de origen de los animales infectados. Recapacitemos un poco y notaremos cuán absurdos resultan para el país de origen y para el que importa.

Trátese de poblar de animales demésticos un territorio, de aumentar su riqueza pecuaria, de mejorar la ganadería con la introducción de los animales de pura raza, o de importar carnes muertas; bajo cualesquiera de estas formas el acto realizado es industrial y comercial; y bien considerado puramente comercial, ya que la industria es en gran parte la aplicación de la sabiduría humana a la obtención del mayor rendimiento con el menor costo posible.

Abaratar la vida es obra de capacidad y de bondad, ¿es posible que ello suceda en materia ganadera si nos limitamos a rechazar lo malo? Lo nocivo repudiado aumentará forzosamente el precio de lo que haya escapado a la contaminación; y el país donde reinen las enfermedades la miseria no tardará en aparecer.

Hay en ambos casos esencial fundamento económico que salvar, lográndose únicamente mediante el esfuerzo mancomunado que lleve a la prevención y extinción de las enfermedades en todos los distritos ganaderos. Evitar las enfermedades no es solamente sostener la salud; es el factor más importante de la propagación de las especies.

Bien mirado la sola utilidad peculiar a los animales sanos es la reproducción y esto significa abundancia que trae aparejada el abaratamiento en las transportaciones de las carnes, de las numerosas industrias que se hacen con los despojos de los animales, tanto mejor servidas cuanto más cantidad haya. Así considerada la ganadería es magno problema mundial; y la acción internacional ha de recaer en el acuerdo unánime de desenvolverla sana y pujante con la aplicación estricta de las medidas sanitarias en los países concordantes.

¿Es esto fácil de realizar entre los países americanos? No, defendiéndose cada país de las infecciones ajenas con medidas restrictivas cual dentro de murallas chinas. Sí, y muy beneficiosa para la riqueza pecuaria de todos, al llegarse a un acuerdo sobre métodos sanitarios de desarrollo y cría de los animales domésticos.

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Algo parecido a esto se ha hecho en medicina humana, con la fiebre amarilla, intenso foco que en Cuba consumía anualmente crecido número de vidas, constituyendo continua amenaza para las costas de los Estados Unidos y otros países.

Mientras fué Cuba colonia del poder español, las medidas restrictivas de los Estados Unidos no pudieron impedir algunos brotes en sus regiones del sur, ni tuvieron la menor influencia en el descenso de la mortalidad en nuestro suelo. Terminada la dominación española, el primer empeño del Gobierno americano fué buscar las medidas que localizaran el foco y que lo extinguieran.

Conseguida la extirpación de la fiebre amarilla cesó la intensa y continua perplejidad en la gran nación vecina, y se convirtió en sólido fundamento del desarrollo de nuestra población, que se ha duplicado en poco tiempo, trayendo como consecuencia lógica el mayor desenvolvimiento industrial y comercial que se ha visto en Cuba, cuyo continuo ascenso hace vislumbrar épocas de gran esplendor y riqueza.

La misma campaña contra otras endemias lograría idénticos resultados, y aplicada a la zoología los efectos serían aun más firmes y de más rápida conclusión, si se tiene en cuenta que a los animales se les puede aplicar trascendental medida sanitaria: el sacrificio, medio enérgico, propicio y eficaz, para suprimir los focos infecciosos.

Dado el adelanto de la medicina, podemos decir que no hay verdaderamente una patología humana y una patología veterinaria, sino patología comparada, pues generalmente las enfermedades atacan a los seres vivos en todas las regiones movidas por las mismas causas, y la excepción estriba en cuanto a que algunas varían con las condiciones climatológicas, las menos en número son peculiares a determinadas regiones, otras se desconocen en algunos países: el carbunco bacteririano, el muermo, el tétano, el cólera porcino, por ejemplo, obedecen, donde quiera que se desarrollen, a la presencia de agentes y virus específicos; la tuberculosis, producida por el bacilo de Koch, determina menos estragos en las regiones cálidas que en las templadas y frías; algunas tripanosomiasis son propias de determinadas regiones africanas; en nuestro país no existen muchas de las enfermedades que diezman a los animales.

Desde que comenzó la era microbiana se incluyó en el capítulo de perseguibles a determinadas enfermedades contagiosas; y, a pesar de los grandes progresos realizados, actualmente no están todas las que son. Ante la relación, donde faltan enfermedades transmisibles al hombre, otras muchas contagiosas para los animales, algunas que sin trasmitirse de animal a animal producen gran mortandad en ellos, se nota tal desacuerdo en las ideas, que es imposible ponerlas a disposición de una reglamentación mancomunada, ya que las omisiones implican lamentables descuidos en cuanto a la profilaxis y extinción.

Llévanos esta conclusión a estimar que tanto peligro se encierra en las micosis, en las enfermedades parasitarias, como en las engendradas por agentes patógenos bacterioscópicos, o ultra visibles, si se abandonan; que no han de ser solamente perseguibles de oficio las enfermedades que Nocard llamó microbianas: debe extenderse esta acción a todas aquellas que produzcan trastornos de consideración en los seres de la misma especie o de especies distintas.

Cada país tendrá que revisar el estudio de esas enfermedades para encauzarlas, y considerar los métodos que las han de dominar y hacerlas desaparecer; sometiendo el resultado de las investigaciones a las diligencias de un comité directivo internacional encargado de unificarlas.

En nuestro país las enfermedades a virus filtrable son: la rabia, el cólera del cerdo, el moquillo y el tifus de los perros y gatos.

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Las microbianas son; la tuberculosis, el muermo, los carbuncos, el tétano, las contadas septicemias y paterolosis, el mal rojo, las diarreas de los terneros, la difteria aviar, el cólera de las aves, la adenitis equina y la mamitis.

Las enfermedades parasitarias, contagiosas a la especie humana, entre animales, o que, sin trasmitirse de animal a animal, producen seria mortandad, son:

PROTOZOARIOS.

*Rhizopodos:* Pirosoma bigemino (babesia bovis). Causa daño de consideración en el ganado importado no inmune.

*Esporozoarios:* Coccidios oviforme. Frecuente.

VERMES.

*Cestodes:* Tenia equinococo. Frecuente. Cisticerco del cerdo. Frecuente.

*Trematodes:* Distoma hepático. Daña muchísimo a las reses vacunas.

*Ascaridinos:* Ascaris caris. Frecuente. Ascaris galline. Extermina nuestros pollos.

*Estrongilinos:* Estrongilo vasorum. Estrongilos micrurus y pulmonaris. Muy frecuente en los terneros y produce la bronquitis verminosa.

*Filariados:* Filaria canis cordis. Filaria conjuntival de las aves de corral.

*Acantocefalos:* Gigantorico gigas. Muy frecuente.

ARTROPODOS.

*Acaros:* Sarcoptes, soroptes y demodecidos. Ixodidos. Abundantes.

*Dipteros:* Gastrofilus, equis y dermatobias.

Los endozoarios y ectozoarios señalados, así como los que dejamos de mencionar, porque producen ligeros trastornos, son idénticos a los de los continentes europeo y americano, de donde es originaria nuestra ganadería.

¿Qué medida oponemos a tantos estragos? La más eficaz es la empleada contra el muermo, sujeto a la declaración, que se castiga cuando no es espontánea; al aislamiento en establo sanitario apropiado; al sacrificio; a la visita de inspección domiciliaria, que delata los casos sospechosos para someterlos a los efectos del diagnóstico experimental, mediante el empleo de la maleina y de la desviación del complemento; pero adoleciendo del más grave de los errores sanitarios al aplicarse solamente en las poblaciones mayores de veinticinco mil almas, y como éstas son contadas, el desamparo es alarmante en el resto de nuestro territorio.

Los carbuncos se combaten con las vacunaciones; el cólera de los cerdos, con el empleo simultáneo del virus y suero; la rabia usando el tratamiento pasteuriano en la especie humana. Estas solas medidas profilácticas no son suficientes para apagar los focos, ni pueden evitar que el volar de las chispas vuelva a encenderlos. Contra las demás enfermedades nada se ha hecho.

Varias veces se ha intentado promulgar medidas de policía sanitaria, incurriendo en el defecto de limitarlas a reducido grupo de enfermedades, partiendo del temor a las trasmisiones humanas, e indudablemente, si no tuvieran esta espantosa cualidad estarían en el mismo abandono de las demás. Agréguese que las inspecciones de carne en los mataderos, y las inspecciones en los puertos, se hacen sin el auxilio del menor aparato, y se comprenderá que no estamos preparados para ser excelentes exportadores de ganado, ni para defendernos de las enfermedades exóticas.

El Cuerpo Médico-Veterinario Cubano, que ha clamado por tanto abandono, siendo siempre desoído, vería con agrado que surgiera del Congreso Pan-Ameri-

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cano la idea salvadora de que es imprescindible el tomar mancomunadas medidas que defiendan la ganadería de las numerosas asechanzas de muerte.

Podríamos asegurar que, salvo contadas excepciones, en la América Latina se está a la altura de nuestro pequeño nivel sanitario, lo que pone en condiciones precarias para adoptar leyes restrictivas contra otras procedencias, cuando constituímos serios peligros para cualquiera nación.

Si lo fundamental estriba en que distintos países han de velar por el desarrollo sanitario de la riqueza pecuaria de todos, no basta con la constitución de un comité directivo internacional integrado por delegados de las naciones contratantes; necesítase del concurso de comisiones internacionales radicadas en cada país y agregadas a los departamentos de industria animal, que laboren con amplio espíritu de investigación y velen por el exacto cumplimiento de lo estatuído.

Esto no implica la desaparición de las inspecciones sanitarias en las fronteras y los puertos; ellas quedarán para ser el más firme testimonio de que todo lo importado está sano porque todo se desenvuelve ordenadamente en los lugares de procedencia. La mejor seguridad que puede tenerse de la fineza de una harina está en tamizarla.

El comité directivo radicará en los Estados Unidos de América, y las comisiones, en cada país, integradas por los mejores profesores de cada nación; constituyendo la defensa más práctica que pueda darse a la riqueza pecuaria. Los gastos de los delegados correrán por cuenta de las naciones a que pertenezcan, teniendo ambos organismos carácter permanente.

### CONCLUSIONES.

La importancia que tiene el desarrollo de la riqueza pecuaria para el comercio, el tráfico, la alimentación, e industrias numerosas, obliga a que se ejerza acción internacional que dicte leyes, cuya finalidad será la de aumentar ese capital en cada nación, y lograr que deje de ser un peligro su desenvolvimiento. A fin de conseguir este objeto, se formulará un tratado por el cual quedará estipulado lo concerniente a la acción sanitaria mancomunada.

Por dicho tratado se creará un comité directivo internacional, que radicará en Wáshington; y comisiones internacionales que se fijarán en cada país contratante y precisamente en su zona más ganadera. Las comisiones quedarán obligadas a realizar investigaciones y trabajos experimentales, remitiendo sus estudios al comité directivo. Será obligación del comité directivo formular, con los antecedentes remitidos por las comisiones, el reglamento profiláctico y curativo de las enfermedades de los animales en todos y cada uno de los distintos países.

Dictar leyes puramente restrictivas contra la importación, y discurrir, con mayor o menor erudición, sobre los conocimientos científicos aplicables a la extinción de las enfermedades, equivale a sostener el perjudicial *statu quo*, por el cual se seguirá haciendo nó lo que se debe, sino, simplemente, lo que se quiere o puede. Terminamos esta labor de acuerdo con el Doctor Monlau, al hablar de la organización higiénica de las naciones: "La codificación sanitaria que pretendemos es tan urgente e importante, como la codificación civil y la criminal, con las cuales tiene más de un punto de relación y contacto."

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## ¿ES FACTIBLE LA REGLAMENTACIÓN UNIFORME ENTRE LOS DIFERENTES PAÍSES AMERICANOS PARA LA PREVENCIÓN DE LA INTRODUCCIÓN Y PROPAGACIÓN DE LAS ENFERMEDADES DE ANIMALES?—PREVENCIÓN Y EXTIRPACIÓN DE LAS ENFERMEDADES DESTRUCTORAS DE ANIMALES.

Por RAFAEL MUÑOZ XIMÉNEZ,
*Inspector Nacional de Policía Sanitaria Animal del Uruguay.*

La importancia y valorización que han alcanzado las ganaderías de los países americanos y el número crecido de enfermedades que conspiran contra esa riqueza, han obligado a la mayor parte de las naciones del continente a dictar leyes de policía sanitaria que garanticen la prosperidad de la industria pecuaria, poniendo los medios para impedir la introducción de enfermedades exóticas y combatir al mismo tiempo las enzootias o epizootias de cada localidad o región.

Pero para que esa lucha dé los resultados satisfactorios que con ella se persiguen, es conveniente y hasta necesario que se siga un plan armónico entre los diversos países americanos que por razones de vecindad o de identidad de intereses puedan facilitar la ejecución de las medidas sanitarias y asegurar el éxito de los métodos o sistemas puestos en vigencia.

Además de estas ventajas de orden sanitario, la reglamentación uniforme traería como consecuencia otras no menos importantes de carácter comercial, facilitando las transacciones internacionales de ganado, puesto que la confianza en la acción desarrollada en los demás países disminuiría las trabas y requisitos que hoy rigen para la importación de animales, cualesquiera que sea su procedencia, y que no tendrían razón de ser el día en que en todas las naciones americanas se respondiera por igual de la sanidad de su riqueza ganadera.

Tales fueron los móviles que indujeron al Gobierno de la República Oriental del Uruguay a convocar en el año 1912 una Conferencia Internacional Americana de Policía Veterinaria que se reunió en la ciudad de Montevideo y en la que se hallaban representados los Gobiernos del Uruguay, Argentina, Brasil, Chile y Paraguay.

Corresponde pues a nuestro país el honor de la primera iniciativa tendiente a establecer una reglamentación sanitaria uniforme entre los diferentes países americanos para prevenir la introducción y propagación de las enfermedades de los animales.

En esa Primera Conferencia Internacional de Policía Veterinaria, celebrada en el año 1912 en la ciudad de Montevideo por iniciativa del Gobierno de la República Oriental del Uruguay, se suscribió el siguiente convenio que rige actualmente entre las naciones contratantes:

Su Excelencia el Señor Presidente de la República Argentina; Su Excelencia el Señor Presidente de los Estados Unidos del Brasil; Su Excelencia el Señor Presidente de la República de Chile; Su Excelencia el Señor Presidente de la República del Paraguay; y Su Excelencia el Señor Presidente de la República Oriental del Uruguay;

Deseando precaver el contagio de las enfermedades en los animales por medio de una reglamentación sanitaria internacional, han resuelto celebrar un convenio, al efecto, y han nombrado por plenipotenciarios:

Su Excelencia el Señor Presidente de la República Argentina, al Señor Enviado Extraordinario y Ministro Plenipotenciario Don Enrique B. Moreno;

Su Excelencia el Señor Presidente de los Estados Unidos del Brasil al Sr. Dr. Don Carlos Botelho;

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Su Excelencia el Señor Presidente de la República de Chile al Señor Ministro Residente Don Marcial Martínez de Ferrari;

Su Excelencia el Señor Presidente de la República del Paraguay a los Sres. Dr. Don Luis Abante Haedo y Dr. Don José P. Montero;

Y Su Excelencia el Señor Presidente de la República Oriental del Uruguay al Sr. Dr. Don Manuel B. Otero;

Quienes, después de haberse comunicado sus respectivos plenos poderes que hallaron en buena y debida forma, han convenido en lo siguiente:

### Convención Internacional de Policía Veterinaria.

Artículo 1°.—Los Gobiernos de los países contratantes, convienen en organizar en los lugares de su frontera o en los que consideren oportunos, un servicio de policía veterinaria suficiente para impedir la introducción de animales afectados por enfermedades contagiosas o sospechosos de estarlo.

Art. 2°.—En las Estaciones de Observación Sanitaria se emplearán todos los procedimientos experimentales que permitan afirmar un diagnóstico seguro (como tuberculina, maleina, etc.).

Art. 3°.—Convienen también en prohibir la importación de productos animales, forrajes u objetos que pueden ser vehículos demostrados de enfermedades contagiosas—considerando como tales cuando acompañen o procedan de animales enfermos o sospechosos de estarlo.

Art. 4°.—Los Gobiernos respectivos establecerán precisamente en sus reglamentos las medidas de desinfección de los lazaretos, buques, vagones y lugares pertinentes cuando se hubiere producido algún caso de peste bovina, perineumonia contagiosa, muermo, fiebre aftosa, durina, viruela ovina, peste porcina, o de otra enfermedad contagiosa, grave aguda y de propagación rápida.

Art. 5°.—Establecerán también la forma y requisitos de los certificados que deben presentarse como garantía de que los animales vienen de procedencias limpias, las planillas e informaciones que presentarán los capitanes de buques que conduzcan ganado y las principales anotaciones de los registros que deberán llevarse en las inspecciones de importación.

Art. 6°.—Los países contratantes organizarán un servicio de policía veterinaria suficiente y dependiente de una administración central, para combatir las enfermedades exóticas y las existentes que cada uno considere oportuno. Se considerarán para ese efecto, como exóticas las enumeradas en el artículo 4°.

Art. 7°.—Establecerán precisamente el alcance y efecto de la declaración de infección de una región o localidad determinada, así como lo que debe entenderse por regiones o localidades sospechosas.

Al solo objeto de las enfermedades exóticas a que se refiere el artículo anterior, se considerarán infectadas las localidades donde ocurran casos repetidos y se considerarán sospechosas las que estén próximas o en fácil comunicación con otra infectada.

Art. 8°.—Los Gobiernos de los países contratantes se informarán recíprocamente, por el órgano y por los medios que determinen los respectivos reglamentos, la aparición y existencia de toda enfermedad contagiosa grave aguda y de propagación rápida, cualquiera sea su origen y naturaleza.

Art. 9°.—Los Gobiernos de los países contratantes además de las medidas generales establecidas en los artículos 1°, 2°, 3°, 4° y 5° de esta convención que crean conveniente aplicar, reglamentarán por convenios especiales el tráfico de ganado entre países limítrofes, indicando las medidas de policía veterinaria aplicables en cada caso según el destino del mismo.

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ART. 10°. La convención entrará en vigor inmediatamente de ser ratificada, durará cuatro años y no siendo denunciada seis meses antes por alguna de las partes contratantes se considerará prorrogada por igual período.

La denuncia no producirá efecto sino para la parte que la formula.

ART. 11. Queda abierto el protocolo de esta convención para que puedan acceder a sus disposiciones los otros países americanos que deseen hacerlo. Para este efecto deberán comunicarse con el Gobierno de la República Oriental del Uruguay, el que hará saber la accesión a los Gobiernos de los países contratantes.

En fe de lo cual, los plenipotenciarios firman la presente convención y colocan sus sellos.

Escrita en Montevideo a los ocho días del mes de mayo del año mil novecientos doce en un solo ejemplar que quedará depositado en los archivos del Gobierno de la República Oriental del Uruguay y del que se remitirán copias conformes certificadas a las potencias contratantes por vía diplomática.

L. S. ENRIQUE B. MORENO,
L. S. CARLOS BOTELHO,
L. S. A. MARTÍNEZ DE FERRARI,
L. S. LUIS ABANTE HAEDO,
L. S. José P. MONTERO,
L. S. MANUEL B. OTERO.

VOTOS SANCIONADOS POR LA CONFERENCIA.

1°. Es de desear (en los países cuyo sistema institucional lo permita) que sin perjuicio de la ratificación de práctica, esta convención entre en vigencia provisional inmediatamente de ser aprobada por el Poder Ejecutivo de las partes contratantes y que no sea derogada sino con aviso previo de seis meses, salvo el caso de que el Honorable Congreso respectivo modificara fundamentalmente su texto o negara su ratificación.

2°. Es de desear que los Gobiernos de los países contratantes reglamenten las disposiciones de esta convención, como ya lo ha proyectado la delegación a esta conferencia de la República Oriental del Uruguay; mereciendo por esta labor un aplauso de la conferencia.

3°. Es de desear que los respectivos Gobiernos publiquen regularmente un Boletín de Policía Veterinaria, que sea la expresión fiel del estado sanitario de su ganado.

4°. Es de desear que los Gobiernos de los respectivos países inviten a las autoridades sanitarias de los países contratantes a enviar delegados cada vez que aparecieren en sus ganados enfermedales contagiosas que constituyan un objeto de estudio interesante para las autoridades sanitarias de otros.

5°. Es de desear que los Gobiernos de los países contratantes promuevan la reunión de Conferencias Internacionales de Policía Veterinaria con períodos de intervalos no mayores de cuatro años.

Vemos pues, que no sólo es factible la reglamentación sanitaria uniforme en los países americanos, sino que ella ha tenido un principio de realización en el convenio que acabamos de transcribir y que contiene los principios fundamentales que deben presidir la lucha contra las enfermedades del ganado dentro de las fronteras y en las relaciones de comercio internacional.

Esta obra tan bien comenzada es susceptible sin embargo, de ser mejorada y perfeccionada.

El mencionado convenio sólo está suscrito por cinco naciones del continente americano: Uruguay, Brasil, Argentina, Chile y Paraguay. Contiene votos o

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aspiraciones que por su importancia y trascendencia pueden y deben ser motivo de su incorporación a los convenios posteriores.

Y por último sería de desear que esa enumeración de principios fundamentales a que se llegó en la primera conferencia internacional fuera dignamente complementada con la adopción de medidas prácticas y precisas que facilitaran eficazmente el intercambio de animales y productos entre todas las naciones americanas.

Para realizar esa obra podría prestarse el proyecto de reglamentación uniforme entre los países americanos contratantes que formuló la delegación uruguaya y redactó el autor de este trabajo, dando lugar a la emisión del segundo voto de la conferencia que dice: "Es de desear que los Gobiernos de los países contratantes reglamenten las disposiciones de esta convención, como lo ha proyectado la delegación a esta conferencia de la República Oriental del Uruguay, mereciendo por esta labor un aplauso de la conferencia."

El proyecto en cuestión es el siguiente:

PROYECTO DE REGLAMENTACIÓN UNIFORME ENTRE LOS PAÍSES CONTRATANTES.

SECCIÓN I.—*Medidas sanitarias en la frontera.*

1°. Todos los animales y productos de procedencia animal que se introduzcan al país por tierra o por mar serán inspeccionados por veterinario diplomado de la Oficina de Policía Sanitaria Animal.

2°. El Poder Ejecutivo determinará los puertos y pasajes de la frontera terrestre habilitados para la importación de animales, los cuales deberán estar provistos de locales apropiados para la observación y cuarentena del ganado.

3°. Queda prohibida la importación al territorio de la República por cualquier punto de sus fronteras, de todo animal atacado o sospechoso de estarlo de cualquiera enfermedad bacteriana o parasitaria contagiosa, así como sus despojos o cualquier objeto que haya estado en contacto con ellos y sea susceptible de trasmitir gérmenes infecciosos.

4°. Los animales de la especie bovina que se importen de ultramar serán sometidos a la prueba de la tuberculina a cuyo efecto deberán mantenerse en observación durante 30 días, ordenándose el sacrificio inmediato de todos aquellos animales que diesen una reacción diagnóstica específica de tuberculosís. Los bovinos que dieran una reacción dudosa quedarán sometidos a una nueva observación en el mismo lazareto durante otros 30 días, sacrificándose los que resultaren tuberculosos o sospechosos nuevamente. Exceptúandose de la prueba de tuberculina los terneros menores de seis meses salvo caso de que las madres diesen reacción positiva.

5°. El ganado equino procedente de ultramar o de cualquiera de los países americanos en donde exista el muermo será sometido a observación cuarentenaria durante ocho días. Terminado el período de cuarentena será maleinizado, sacrificándose todos aquellos animales que raccionen así como los que hubiesen estado en contacto directo o indirecto con los enfermos.

6°. Para la substitución de la tuberculina y maleína como reactivos de la tuberculosis y del muermo así como para la adopción de otras substancias reveladoras de cualquier enfermedad contagiosa, será preciso un acuerdo previo entre las partes contratantes.

7°. El ganado ovino, caprino y porcino procedentes de ultramar será mantenido en observación sanitaria durante 15 días.

8°. Los animales de cualquiera clase no comprendidos en la determinación de ganado, sea cual fuere el país de origen, podrán ser sometidos a inspección veterinaria, puestos en observación sanitaria aislados, sacrificados, según lo que en cada caso determinen las oficinas sanitarias de los respectivos países.

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9°. Todo buque que transporte ganado destinado a la importación será inspeccionado por un veterinario oficial inmediatamente después de su entrada al puerto o antes de entrar a él cuando así se crea conveniente y sólo se permitirá el desembarque de los animales cuando se haya comprobado su perfecto estado sanitario, adoptándose en caso contrario las medidas siguientes:

(*a*) Si se comprobara o sospechara la existencia de peste bovina o que durante el viaje hubiera ocurrido algún caso de esta enfermedad, se ordenará la inmediata salida del buque y el sacrificio de todo animal que tenga a bordo y no se permitirá el arribo del buque ni el desembarco de los pasajeros, tripulantes y cargamento, hasta tanto no se haya efectuado una rigurosa desinfección del buque y de toda persona, mercadería u objeto que pueda servir de vehículo al contagio.

(*b*) Si se comprobara o sospechara la existencia de peripneumonia contagiosa, de muermo, viruela ovina, o que durante el viaje hubiera ocurrido algún caso de aquellas enfermedades se ordenará la inmediata salida del buque y el sacrificio de todos los animales atacados o sospechosos así como el de los demás animales susceptibles de contraer la enfermedad y no se permitirá que el buque penetre al puerto sin previa desinfección de los sitios, objetos, animales y personas que puedan servir de vehículo a los gérmenes de la enfermedad comprobada o sospechosa.

(*c*) Si se comprobara o sospechara la existencia abordo de animales atacados de carbunclo sintomático o bacteridiano, sífilis equina, fiebre rosada, pneumo-enteritis de los cerdos, fiebre aftosa o de rabia se ordenará su sacrificio y si no se juzgara conveniente hacer lo mismo con los contaminados serán estos desembarcados y sometidos al aislamiento cuarentenario durante el tiempo que se considere necesario en cada caso.

(*d*) Los animales atacados de sarna actinomicosis u otras enfermedades parasitarias o bacterianas serán sacrificados, rechazados, aislados o curados según determinen las autoridades correspondientes.

10°. Si durante la permanencia de los animales importados en el Lazareto cuarentenario se produjera algún caso de enfermedades contagiosas, se procederá de la siguiente manera:

(*a*) Cuando se trate de peste bovina se ordenará el sacrificio del animal enfermo y de todos los demás existentes en el lazareto.

(*b*) Cuando la enfermedad constatada fuera peripneumonia contagiosa o muermo se ordenará el sacrificio del animal atacado y de todos los demás susceptibles de contraer el contagio.

(*c*) Si se produjera algún caso de viruela ovina, carbuncio sintomático o bacteridiana, fiebre rosada, pneumo-enteritis de los cerdos o de sífilis equina se ordenará el sacrificio de los enfermos y el aislamiento de todos los animales susceptibles de contraer la enfermedad, hasta pasados 15 días de producido el último caso.

(*d*) Si se produjera algún caso de rabia se ordenará el sacrificio del animal atacado y de los que con él hubieran estado en contacto.

En todos los casos previstos en este artículo los cadáveres serán quemados y sometido a rigurosa desinfección todo cuanto haya estado en contacto con los enfermos o sospechosos.

11. El sacrificio de los animales que de acuerdo con las disposiciones sanitarias se ordenaron en los puertos, pasajes de la frontera terrestre y en los lazaretos cuarentenarios no dará lugar a ningún género de indemnización.

12. Queda prohibida:

(A) La importación de animales en general de especie determinada procedente de cualquiera nación donde exista la peste bovina, peripneumonia

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contagiosa, fiebre aftosa, viruela ovina, así como la fiebre rosada y pneumo-enteritis de los cerdos con carácter epizoótico.

(B) La importación de animales procedentes de naciones cuyas leyes y reglamentos sanitarios no presenten suficientes garantía contra la introducción del contagio.

(C) La importación de animales procedentes de naciones cuyos ganados puedan ser introducidos cuando aquellos animales sean originarios de una nación prohibida y no hayan permanecido por lo menos un año en el país de su última procedencia.

(D) La importación de ganados transportados en un buque que haya cargado animales en una nación prohibida dentro de los 30 días anteriores a la fecha de su embarque.

(E) La importación de ganado transportado en un buque que después de cargado haya estado en contacto con cualquiera clase de animales procedentes de una nación prohibida.

(F) La entrada a los puertos de todo buque que durante 60 días anteriores hubiere cargado animales de cualquier especie en una nación prohibida por existir en ella la peste bovina o que conduzca animales de cualquiera nación prohibida sea cual fuera el motivo de la prohibición.

13. Los capitanes de buques que conduzcan ganados deberán proveerse antes de recibir los animales a bordo, de un certificado expedido por el Ministerio de Agricultura u oficina que haga sus veces en la nación de origen, legalizado por el cónsul del país de destino, y que acredite:

(A) Cuando se transporte ganado bovino:

1°. Que en el país de origen no existe ni ha existido en los dos años anteriores la peste bovina.

2°. Que no existe ni ha existido en los seis meses anteriores la peripneumonia contagiosa ni la fiebre aftosa.

3°. Que en las seis semanas anteriores no ha ocurrido ningún caso de enfermedad contagiosa en los animales de las misma especie.

(B) Cuando se transporte ganado equino:

1°. Que en el país de origen no existe ni ha existido en los dos años anteriores la peste bovina.

2°. Que no existe ni ha existido en los seis meses anteriores el muermo con carácter epizoótico y que en el mismo tiempo en el Departamento o Provincia de donde proceden los animales no ha ocurrido ningún caso de esta enfermedad.

3°. Que en las seis semanas anteriores no se ha producido ningún caso de enfermedad contagiosa en los animales de la especie.

(C) Cuando se transporte ganado ovino o caprino:

1°. Que no existe ni ha existido en los dos años anteriores la peste bovina.

2°. Que en los seis meses anteriores no se ha producido ningún caso de fiebre aftosa.

3°. Que no existe ni ha existido en los seis meses anteriores la viruela ovina, con carácter epizoótico y que en el Departamento o Provincia de donde procede el ganado no se ha producido durante el mismo tiempo ningún caso de aquella enfermedad.

4°. Que en las seis semanas anteriores no ha ocurrido ningún caso de enfermedad contagiosa en los animales de la especie.

(D) Cuando se transporte ganado porcino:

1°. Que no existe ni ha existido en los dos años anteriores la peste bovina.

2°. Que en los seis meses anteriores no se ha producido ningún caso de fiebre aftosa.

3°. Que no existe ni ha existido en los seis meses anteriores la fiebre rosada y la pneumo-enteritis de los cerdos con carácter epizoótico y que durante el

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mismo tiempo no se ha producido en el Departamento o Provincia de donde proceden los animales ningún caso de dichas enfermedades.

4°. Que en las seis semanas anteriores no se ha producido ningún caso de enfermedad contagiosa en los animales de la especie.

14. Todo importador de reproductores puros deberá entregar al veterinario oficial en el momento de efectuarse la inspección sanitaria a bordo la genealogía de los animales y una fotografía (9x12 como mínimum), tomada de perfil de cada uno de los reproductores a que aquéllos pertenezcan; fotografía que deberá venir sellada y fechada por el cónsul del país de destino.

15. Cumplida la observación sanitaria que en cada caso corresponde, la Oficina de Policía Sanitaria devolverá las genealogías, registradas e intervenidas con un sello que contenga la declaración de admitido con la fecha de la resolución y el número de orden que corresponda en el registro de importación prohibiéndose en absoluto la inscripción en los registros genealógicos de todo pedigree en que no se haya llenado ese requisito. Los pedigrees de los animales que murieran en el viaje o durante la observación sanitaria, así como los de los sacrificados durante ese período, quedarán archivados en la oficina respectiva la que dará cuenta de ello y de la muerte del animal a la Dirección de los Registros Genealógicos del país de origen.

16. Los capitanes de buques que transporten ganado deberán presentar al veterinario inspector, inmediatamente de arribado el buque, además del certificado establecido en el artículo 13:

1°. Una planilla en la que conste el número, especie, raza, sexo, propietario y destinatario de los animales, el puerto y la fecha en que fueron embarcados, especificando el número de animales que hayan muerto durante el viaje con indicación de la causa aparente de su muerte y los síntomas observados.

2°. Una declaración en la que se determine:

(*a*) Los furgones donde haya cargado animales en los 30 días anteriores a la fecha de embarque de los animales que transporta.

(*b*) Los puertos en que ha entrado o recalado después de haber cargado los animales que transporta.

(*c*) La procedencia de los animales que hayan estado en contacto a bordo con los animales conducidos.

17. Todos los productos alimenticios de origen animal que se introduzcan al país deberán venir acompañados de un certificado expedido por el Ministerio de Agricultura u oficina que haga sus veces atestiguando que proceden de establecimientos sujetos a inspección veterinaria y que se hallan en buenas condiciones higiénicas. Se procederá asimismo al rechazo de los productos que carezcan del correspondiente sello sanitario y de aquellos que su embalaje sea defectuoso.

18. Queda prohibida la importación de forrajes y de productos animales que procedan de países donde exista la peste bovina o la peripneumonia contagiosa.

19. Todos los animales que vayan a ser exportados serán inspeccionados por el personal de la Oficina de Policía Sanitaria de los Animales prohibiéndose la salida del país a todo animal atacado de cualquiera enfermedad contagiosa.

20. El Poder Ejecutivo prohibirá la exportación de los animales procedentes de secciones o Departamentos que fuesen declarados infectados: prohibición que cesará a los 20 días de haberse dado por limpia la sección, Departamento o Provincia infectados.

21. Los agentes marítimos tienen la obligación de comunicar a la Oficina de Policía Sanitaria Animal del país de donde procedan los animales embarcados, todas las novedades que durante el viaje hayan ocurrido en el ganado exportado, dentro de los tres meses a contar desde el día en que el buque haya salido, prohibiéndose el despacho de otros buques a las empresas que no cumplan con esta obligación.

68436—17—VOL III——60

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SECCIÓN II.—*Medidas de policía sanitaria interna.*

22. El Poder Ejecutivo hará efectiva la defensa de los ganados contra la invasión de las enfermedades contagiosas exóticas y la propagación de las que pudieran aparecer dentro del territorio de la Republica por los medios indicados en la presente convención y en las leyes y reglamentos respectivos.

23. Las enfermedades de los animales que darán lugar a la aplicación de las medidas sanitarias serán:

Rabia, carbunclo bacteridiano y tuberculosis en todas las especies.

Peste bovina en todas las especies de rumiantes.

Peripneumonia contagiosa, carbunclo sintomático y tristeza en los bovinos.

Muermo y sífilis equina en los equinos.

Fiebre aftosa en los bovinos, ovinos, caprinos y porcinos.

Viruela ovina y sarna en los ovinos y caprinos.

Fiebre rosada y pneumo-enteritis en los porcinos.

Queda facultado el Poder Ejecutivo para aumentar el número de las enfermedades citadas, así como para aplicar las medidas sanitarias a otras especies animales no comprendidas en este artículo.

24. Todo propietario de animales y toda persona que tenga a su cuidado algún animal sosprechoso de estar atacado de alguna enfermedad contagiosa tiene la obligación de denunciar el hecho ante la comisaría de policía más inmediata a donde se aloja el animal. La misma declaración es obligatoria respecto de los animales muertos o que se supongan muertos de enfermedades contagiosas.

25. El comisario de policía ante quien se haya hecho la denuncia que establece el artículo 24 dará cuenta inmediatamente a la jefatura de policía y ésta a su vez a la Oficina de Policía Sanitaria más cercana, la que procederá a tomar las medidas que crea conveniente de acuerdo con lo que determinen los reglamentos sanitarios.

26. Comprobada la existencia de cualquiera de las enfermedades contagiosas a que hace referencia el artículo 23 el Poder Ejecutivo podrá declarar infectada la propiedad, sección, Departamento o Provincia correspondiente según los casos; quedando también facultado para aislar, marcar, secuestrar, inocular, etc., los animales de la zona infectada; prohibir el tránsito, la celebración de ferias y exposiciones; desinfectar la propiedad, caballerizas, establos, galpones y sacrificar los animales infectados según la gravedad del mal, indemnizando a los propietarios con arreglo a lo determinado por las respectivas leyes y reglamentos sanitarios.

27. Todos los veterinarios que tengan bajo su asistencia animales atacados de cualquiera de las enfermedades contagiosas establecidas en el artículo 23, tienen la obligación de denunciarlos a la Oficina de Policía Sanitaria de los Animales. La falta de cumplimiento a esta obligación se castigará con la suspensión en el ejercicio de su profesión hasta por seis meses en el caso de reincidencia.

28. El Poder Ejecutivo adoptará las medidas especiales a cada una de las enfermedades contagiosas teniendo en cuenta el período de invasión, marcha, virulencia, gravedad, modos y medios de propagación de cada una de ellas.

29. En las tabladas, mataderos, ferias, plazas de frutos, exposiciones, bañaderos, saladeros, frigoríficos y en general en todos los establecimientos donde se elaboren productos de origen animal, se establecerá un servicio permanente de inspección veterinaria por veterinarios diplomados.

30. Las personas autorizadas para la venta de vacunas, sueros, tuberculina, maleína y cualquier otro preparado que se emplee en la inoculación de los animales como preventivo, curativo o reactivo de enfermedades contagiosas,

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están obligadas a dar cuenta a la Oficina de Policía Sanitaria de las cantidades de substancias que se expendan y del nombre de las personas que las adquieran.

31. Declárase a la tuberculosis bovina vicio redhibitorio. El adquirente de un animal tuberculoso tendrá derecho a reclamar el precio pagado dentro de los 30 días de la fecha de su entrega por el vendedor. La comprobación de la enfermedad por la Oficina de Policía Sanitaria dará a la acción fuerza ejecutiva.

Cuando la Oficina de Policía Sanitaria compruebe la tuberculosis bovina señalará el animal atacado por medio de una marca a fuego en forma de "T" de cinco centímetros cuadrados colocada en el carrillo izquierdo, y hará la anotación correspondiente en el pedigree de dicho animal dando cuenta a la dirección del registro genealógico respectivo a fin de que ésta haga en sus libros la misma anotación; sin perjuicio de que la Oficina de Policía Sanitaria pueda ordenar el sacrificio le los bovinos tuberculosos que por la forma que revista la enfermedad los considere peligrosos, indemnizando a sus propietarios de acuerdo con lo que establezca el respectivo reglamento sanitario.

32. El Poder Ejecutivo organizará un servicio de policía sanitaria suficiente para—

(*a*) Hacer cumplir lo dispuesto en esta convención y las leyes y reglamentos sanitarios que se dicten.

(*b*) Conocer con prontitud la localidad en que aparezcan las enfermedades, hacer su diagnóstico, determinar su carácter epizoótico y adoptar las medidas de aislamiento y extinción aconsejadas por la profilaxia moderna.

(*c*) Vigilar constantemente el estado sanitario de la ganadería nacional difundiendo los conocimientos científicos acerca de los medios más eficaces que se han de emplear para evitar la aparición y la propagación de las enfermedades de los animales.

33. La declaración de infección es la comprobación oficial de la enfermedad contagiosa y la que da lugar desde luego a la aplicación inmediata de las prescripciones generales de la ley y reglamentos sanitarios en todo el perímetro que la misma declaración de infección determine y que debe comprender no sólo los animales enfermos, sino también los demás animales del mismo propietario o de propietarios diferentes que hayan podido ser contaminados.

34. La declaración de infección implica la adopción de alguna o de todas las medidas siguientes, a juicio del Poder Ejecutivo:

(*a*) Aislamiento, secuestro, vacunación, señal o marca de los animales comprendidos en el perímetro declarado infectado.

(*b*) La intervención momentánea o la reglamentación de ferias, exposiciones, transportes y circulación de ganado.

(*c*) Desinfección y destrucción de objetos según la gravedad y fuerza de contagio de la enfermedad.

(*d*) Sacrificio de los animales infectados según la intensidad y gravedad del mal.

SECCIÓN III.—*Medidas especiales de policía sanitaria entre estados contratantes.*

35. El ganado que se importe por los puertos habilitados y que proceda de cualquiera de los Estados contratantes quedará sujeto a las siguientes medidas sanitarias:

(*a*) Los bovinos destinados a reproducción intensiva serán sometidos durante 10 días a observación sanitaria en el lazareto cuarentenario y tuberculinizados al terminar este plazo, sacrificándose todos aquellos que resulten tuberculosos. Los animales que dieran una reacción que permita declararlos sospechosos, serán sometidos a una nueva observación de 10 días procediéndose a su sacrificio

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inmediato si en la segunda prueba de tuberculina resultaran tuberculosos o sospechosos nuevamente.

(*b*) Los animales de la especie bovina destinados a cría o reproducción extensiva o a invernada quedarán en observación sanitaria durante tres días siendo sometidos durante ese tiempo a los diversos medios de investigación que la Oficina de Policía Sanitaria juzgue necesarios, adoptándose en caso de reacciones positivas o dudosas las mismas disposiciones que para los reproductores bovinos que se destinen a cría intensiva.

(*c*) Lo bovinos importados que vayan a ser inmediatamente sacrificados serán revisados por el inspector veterinario, el que autorizará su desembarque libremente una vez que haya comprobado su buen estado sanitario, otorgando un permiso de importación en el que se hará constar el puerto de destino de los animales así como el número, marcas y señales de los mismos. Este permiso será devuelto dentro de los 15 días siguientes al veterinario inspector que lo otorgó, acompañado de un certificado de sacrificio en el que haga constar igualmente el número, marcas y señales de los animales faenados, extendido por el veterinario oficial del matadero o establecimiento industrial donde los animales fueron sacrificados.

(*d*) El ganado vacuno destinado a cría o reproducción extensiva, a invernada o a ser sacrificado inmediatamente, deberá encontrarse libre de garrapata y el certificado sanitario que lo acompañe deberá atestiguar además de lo establecido en el artículo 13 que dichos animales fueron bañados antes de su embarque en un bañadero oficial o particular autorizado con un garrapaticida reconocido como eficaz por la Oficina de Policía Sanitaria. A los efectos de la importación de ganado el baño sólo tendrá valor hasta los cinco días de efectuado.

(*e*) El ganado equino, ovino, caprino y porcino será inspeccionado en el momento de la llegada del vapor por los inspectores veterinarios oficiales, los que autorizarán su desembarque libremente una vez comprobado su buen estado sanitario y presentada en forma la respectiva documentación.

36. Exceptúanse de las medidas prescriptas en el artículo anterior los animales salidos temporalmente para ser conducidos a exposiciones o ferias de los países contratantes.

37. La restricción de entrada y tránsito no impedirá la circulación por la frontera terrestre de los animales de trabajo y de servicio ni la circulación de los caballos de tiro montados que sirvan a los coches y viajeros y provengan de países contratantes. No obstante los conductores deberán estar provistos de un certificado expedido por un veterinario oficial y que atestigue el perfecto estado sanitario de dichos animales. Este certificado sólo será válido por el término de un mes.

38. Declaranse puertos o pasajes de la frontera terrestre habilitados para la importación de ganados y productos de origen animal procedentes u originarios de los países contratantes, todos aquéllos en donde existan inspecciones veterinarias permanentes.

39. Cuando la Oficina de Policía Sanitaria de cualquiera de los países contratantes procediera al sacrificio o rechazo de animales procedentes de una de las partes signatarias de esta convención, dará cuenta inmediata del hecho a la oficina análoga del país de origen del ganado, especificando las causas que motivaron la adopción de la medida y todos los datos que se juzguen de utilidad en el sentido de evitar el fraude.

40. Todos los certificados, pedigrees o cualquier otro documento que la Oficina de Policía Sanitaria exija, deberán venir legalizados por los cónsules respectivos acreditados en los puntos de embarque o en su defecto en la localidad más próxima.

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41. Los buques que en cualquiera de los puertos de los países contratantes carguen animales en pie o productos de origen animal podrán completar el cargamento en los puertos pertenecientes a las otras naciones contratantes. Las autoridades sanitarias del país donde sea completado el cargamento sólo expedirán documentaciones exactas correspondientes al efectivo de la carga de complemento.

42. En cualquiera de los puertos habilitados de las naciones contratantes podrá efectuarse el trasbordo de animales en pie o productos de origen animal que provengan o se destinen a los países signatarios.

43. Todos los trasbordos de animales y sus productos serán vigilados por el veterinario oficial del país en cuyo puerto se efectúe dicho trasbordo y la Oficina de Policía Sanitaria dará aviso inmediatamente a su análoga del país contratante de origen o de destino, de la operación efectuda y novedades ocurridas.

44. Los buques que conduzcan los animales en pie de cualquier país con destino a las partes contratantes, serán inspeccionados por las autoridades sanitarias del primero de los países signatarios a que arribe el buque. Si las autoridades sanitarias que primeramente inspeccionen el buque comprobaren que entre los animales embarcados existe alguno atacado de enfermedad enzoótica o epizoótica tomarán inmediatamente las medidas de urgencia a que las autorice sus respectivos reglamentos sanitarios y comunicarán por la vía más rápida posible a la Oficina de Policía Sanitaria del país de destino las novedades ocurridas a bordo y las medidas adoptadas.

45. Si los buques que conduzcan animales en pie o productos animales de o para cualquiera de las naciones contratantes, por causa de fuerza mayor tuvieran que arribar a otro puerto que aunque perteneciente a las naciones contratantes no fuera el de destino o escala, se les vigilará por las autoridades sanitarias, y se comunicará a las autoridades del país signatario en que hayan sido cargados o a que vayan destinados las medidas tomadas y las novedades ocurridas en la arribada forzosa.

46. Los buques que conduzcan animales en pie o productos de origen animal de una nación contratante podrán tomar para el consumo a bordo, animales en pie o faenados, aves, etc., en cualquiera de los puertos pertenecientes a cualquiera de las otras partes contratantes, sujetándose sus capitanes a lo establecido en los reglamentos respectivos de la nación donde el cargamento de consumo se realice.

47. Las partes contratantes cambiarán entre sí una circular telegráfica quincenal indicando brevemente el estado sanitario de los respectivos países, sin que esto obste a que se dé aviso inmediatamente de la aparición de cualquiera epizootia, marcha del mal, medidas que se tomen para combatirlo, levantamiento de las mismas, novedades ocurridas en los buques procedentes o con destino a los países contratantes y todos aquellos informes que se consideren de utilidad para la defensa de la ganadería de los respectivos países.

Para la tramitación de todos los informes, la Oficina de Policía Sanitaria de las partes contratantes se dirigirá directamente y por telégrafo a sus similares de los países signatarios, sin perjuicio de que se sigan además en cada caso las vías diplomáticas ordinarias.

48. Los países contratantes adoptarán un código telegráfico para uso exclusivo de sus autoridades sanitarias ganaderas.

49. Los países contratantes facilitarán en todo lo posible la acción de los delegados que en misión de estudio de enfermedades del ganado enviare cualquiera de ellas. Al efecto estos delegados presentarán antes las autoridades sanitarias correspondiente los documentos que los acrediten como tales.

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50. La Oficina de Policía Sanitaria de las partes contratantes se comunicará directamente y por vía telegráfica las medidas que sus respectivos Gobiernos hayan adoptado contra la importación de animales de determinados países debiéndose ratificar la comunicación por la vía diplomática a la brevedad posible. Los países signatarios que no creyeran conveniente adoptar igual resolución no podrán exportar, con destino al país que haya dictado las medidas prohibitivas, todas las especies de animales o especie determinada, según los casos que hayan procedido en el año anterior del país contra el cual se haya distado la resolución comunicada.

51. Queda abierto el protocolo de esta convención para que puedan adherirse a las disposiciones del mismo otros países sudamericanos especialmente invitados para ello, de acuerdo entre los países signatarios.

52. Esta convención entrará en vigor inmediatamente después de ser ratificada, durará cuatro años y no siendo denunciada seis meses antes por cualquiera de las partes se considerará prorrogada por igual período.

53. Sin perjuicio de la ratificación definitiva esta convención entrará en vigencia provisional inmediatamente después de ser aprobada por el Poder Ejecutivo de las partes contratantes y no será derogada sino con aviso de seis meses, salvo el caso en que el Honorable Congreso de cualquiera de las partes modificara fundamentalmente su texto o negara su ratificación.

Demostrada la posibilidad de llegar a un acuerdo entre las distintas naciones americanas para prevenir y exterminar de manera uniforme las enfermedades del ganado, faltaría ahora dar a la obra vastas proyecciones y verdadera finalidad práctica. Para ello sería preciso promover una Segunda Conferencia Internacional de Policía Veterinaria en que estuvieran representadas todas o el mayor número de las naciones americanas y que teniendo como base el convenio vigente entre las Repúblicas del Uruguay, Argentina, Brasil, Chile y Paraguay y el proyecto de reglamentación uniforme formulado por la delegación uruguaya ante la primera conferencia, se llegare a un nuevo convenio que estableciera las medidas sanitarias de la frontera para las procedencias de los países no contratantes; las disposiciones que garantizaran en cada país la lucha interna; y por último y como una consecuencia de esas primeras obligaciones, las medidas sanitarias especiales que regirán entre los estados contratantes para facilitar el intercambio comercial.

### CONCLUSIONES.

1°. Es factible la reglamentación uniforme de las medidas sanitarias para prevenir y combatir las enfermedades del ganado, en los distintos países americanos.

2°. Esa reglamentación uniforme ha tenido un principio de ejecución en la Primera Conferencia Internacional de Policía Veterinaria convocada por el Gobierno de la República Oriental del Uruguay y en el convenio suscrito con tal motivo en Montevideo por los delegados de las Repúblicas del Uruguay, Argentina, Brasil, Chile y Paraguay.

3°. Sería de desear que se completara y ampliara la obra iniciada convocándose a una Segunda Conferencia Internacional Americana de Policía Veterinaria en que estuvieran representadas todas las naciones del continente y a la que se le podría dar como base de su trabajo, el convenio actualmente vigente entre las Repúblicas del Uruguay, Argentina, Brasil, Chile y Paraguay y el proyecto de reglamentación uniforme de policía sanitaria entre las naciones contratantes, formulado por la delegación uruguaya ante la conferencia de 1912.

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## ¿ES FACTIBLE LA REGLAMENTACIÓN UNIFORME ENTRE LOS DIFERENTES PAÍSES AMERICANOS PARA LA PREVENCIÓN DE LA INTRODUCCIÓN Y PROPAGACIÓN DE LAS ENFERMEDADES DE ANIMALES?

Por JULIO BESNARD,

*Director del Servicio Veterinario Nacional de Chile.*

No obra en nuestro conocimiento motivo alguno que pueda oponerse al establecimiento de una reglamentación general, uniforme, a la que podrían adherirse los diferentes países americanos, con el fin de impedir la penetración de las enfermedades contagiosas del ganado en los territorios conservados hasta ese momento indemnes de una o varias de tales enfermedades.

Si alguno de los países americanos, debido a ciertas razones especiales, se hallare particularmente amenazado por uno o más de sus vecinos con la invasión de enfermedades que teme muy en especial, podrá concluir un acuerdo con ese o esos vecinos a fin de hacer más severas aún, si necesario fuere, las medidas impuestas por el reglamento general.

Explicaremos con más exactitud nuestra idea, aplicando a Chile lo que acabamos de exponer.

A este país no lo liga ningún tratado de policía sanitaria y, por tanto, puede aceptar sin impedimento alguno una reglamentación general. Aprovecharemos la ocasión para declarar que al manifestar la gran satisfacción que les proporcionaría la oportunidad de colaborar en la adopción y aplicación de una medida protectora tan importante, estamos seguros de interpretar la opinión del Gobierno y de los agricultores chilenos.

La República de Chile tiene sólo tres países vecinos: las Repúblicas del Perú, Bolivia y Argentina. Los dos primeros no son productores de ganado en las regiones más o menos desiertas que forman sus fronteras; únicamente la Argentina exporta animales a Chile por la cordillera de Los Andes. Todas las otras importaciones se efectúan por vía marítima.

Sería del caso, pues, si fuere necesario, establecer una convención especial entre las dos Repúblicas, adhiriéndose ambas, al mismo tiempo, al reglamento general.

### CONCLUSIÓN.

Podemos admitir que Chile se adheriría persuroso a una convención americana que tuviera por objeto la prevención de la introducción y propagación de las enfermedades de animales.

## PREVENCIÓN Y EXTIRPACIÓN DE LAS ENFERMEDADES DESTRUCTORAS DE ANIMALES.

Por JULIO BESNARD,

*Director del Servicio Veterinario Nacional de Chile.*

Dividiremos estas enfermedades, como es costumbre, en dos grupos: 1°, El de las enfermedades contagiosas; 2°, el de las enfermedades parasitarias.

Nuestras indicaciones sobre los medios de preservación o de extirpación que nos parecen mejor estudiados y más eficaces sólo se referirán a las enfermedades que atacan al ganado de Chile, por cuanto ellas han sido objeto de una larga observación de nuestra parte.

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ENFERMEDADES CONTAGIOSAS.

Entre estas enfermedades, citaremos únicamente aquéllas que pueden causar perjuicios de consideración en el país. Algunas de ellas, como el muermo, la peripneumonia, la morriña y la peste porcina, por ejemplo, no han logrado todavía penetrar en el territorio de la República; y por eso nuestros esfuerzos se limitan, por ahora, a preservarlo de estas plagas.

Al enumerar los procedimientos de preservación y de extirpación que nos parecen más indicados para llegar a un resultado satisfactorio, tendremos, pues, en vista principalmente: la tuberculosis, el carbunclo bacteridiano, la fiebre aftosa, la papera, el aborto epizoótico, las enfermedades contagiosas del puerco (enteritis infecciosa, pneumonia contagiosa), el cólera y la difteria de las aves de corral.

1°. Cada vez que exista una vacuna reconocida como verdaderamente eficaz para preservar el ganado de una enfermedad virulenta, deberemos tratar de tenerla siempre a nuestra disposición, en las mejores condiciones posibles.

En ciertos casos, el Gobierno facilitará su preparación utilizando el personal y los laboratorios de que pueda disponer. De este modo, hemos preparado y empleado en Chile desde el año 1886 el virus anti-carbuncloso de Chauveau, habiéndose inoculado con él, hasta la fecha, 4,500,000 animales vacunos.

Además, nos han llegado de la Argentina los virus de Pasteur y Lignières, los cuales han sido puestos a la disposición de los agricultores sin restricción alguna.

La vacuna anti-carbunclosa es la única que usamos para nuestro ganado. En cuanto a las que corresponden a otras enfermedades contagiosas, no tenemos en la actualidad.

Sentaremos, no obstante, que la vacunación preventiva, disminuyendo progresivamente el número de cadáveres que infectan el suelo o los edificios ocupados por los animales, no sólo reduce las pérdidas de capital que representan los individuos muertos, sino que atenúa también las causas de infección para el porvenir.

2°. Esta última consideración, nos induce a recomendar especialmente la pronta y completa desaparición de los cadáveres, ya sea por la combustión u otro medio análogo (baño de ácido sulfúrico, etc.), o bien por el enterramiento en un lugar árido, seco, pedregoso, rodeado de un cierro infranqueable para los animales, formando así un verdadero cementerio permanente.

Los cadáveres enterrados, aún a cuatro metros de profundidad, en un terreno cultivado y mantenido húmedo, constituyen focos de infección durante varios años, a veces diez o doce y más también. Las lombrices terrestres, en tales condiciones, suben a la superficie del suelo las esporas conservadas en la tierra que rodea y que ha penetrado en los cadáveres sepultados, las depositan con sus excrementos en la base del pasto, donde son tomadas después por la lengua de los animales que comen ese forraje, verde o seco.

3°. La penetración de esporas o de cualquiera otra materia virulenta en la boca de los animales, nos conduce a una tercera recomendación en vista del objeto que perseguimos, cual es la extinción progresiva de las enfermedades contagiosas que diezman el ganado.

Se tratará de evitar que los animales tengan la menor herida en la boca, sobre todo las heridas que provoca el consumo de las plantas punzantes: pasto mezclado con la paja de los rastrojos, cardo verde o seco, brotes de los espinos (*Acacia cavenia*) o análogos, etc. La vacunación preventiva permite la utilización de los rastrojos sin grandes riesgos, cuando se trata del carbunclo.

Si la tuberculosis es capaz de contaminar siguiendo este mismo camino, y si consideramos que es una enfermedad que carece hasta ahora de medios pre-

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ventivos, nos parece que las efracciones de las primeras vías digestivas y respiratorias constituyen un peligro que no preocupa suficientemente a los interesados, a pesar de su gravedad.

Debemos vigilar cuidadosamente la conservación de la perfecta integridad de las mucosas de los aparatos digestivo y respiratorio de nuestros animales domésticos, sobre todo, a la entrada, en la boca y la faringe. Evitaremos pues, en la alimentación, el consumo de substancias que pueden lastimar la boca y sus anexos.

4°. Las aguas pueden servir de vehículo a las materias virulentas y propagar, así, tanto las enfermedades de los animales como las de los hombres. El conocimiento de este hecho, nos impone la obligación de evitar que las aguas se contaminen y la de proporcionar a nuestros animales domésticos agua exenta de la menor infección para la bebida.

En los fundos regados se observa a menudo que las aguas, después de recorrer el terreno, se acumulan en las partes bajas formando una o varias lagunitas, donde se depositan los gérmenes infecciosos y las esporas de bacterios patógenos que han recogido en su curso.

Los agricultores no ignoran el peligro que ofrece el consumo de estas aguas por su ganado, aun cuando le atribuyen otras causas que las verdaderas, como son, su elevada temperatura en el verano, por ejemplo. Se comprenderá, en consecuencia, cuánta importancia tiene impedir la estagnación de dichas aguas, asegurar su circulación por medio de acequias a medida que llegan a las partes bajas del fundo y, sobre todo, hacer imposible su consumo por los animales.

Habrá que evitar también, en cualquiera forma, la contaminación de las aguas de riego y otras de las haciendas, puesto que constituye siempre una gran amenaza, aún para el hombre. Lo que precede, nos conduce a formular la regla siguiente: los animales de un fundo no deberán estar nunca expuestos a beber aguas contaminadas con substancias patógenas.

5°. Cuando muere uno o varios animales a consecuencia de una enfermedad contagiosa, no solamente se impone la destrucción de los cadáveres y de las materias patógenas provenientes de sus cuerpos (excrementos, sangre, etc.), sino también la desinfección de los locales que ocuparon los enfermos, pesebreras o establos.

En los potreros, los agentes atmosféricos, el sol principalmente, se encargan de la destrucción de los virus diseminados en la superficie del suelo, en un tiempo variable pero relativamente corto. En los edificios la cosa es muy distinta, ya que el virus se conserva a veces diez años y más, ofreciendo el mismo peligro durante todo este largo período.

En un establo, después de la desaparición de una enfermedad contagiosa, con o sin muerte de animales, se deberá practicar una desinfección apropiada a la naturaleza de la enfermedad, más o menos enérgica, por consiguiente, pero siempre meticulosa y que alcance a las partes más escondidas del edificio contaminado.

Al lado de las enfermedades contagiosas propiamente dichas, debemos señalar las de la misma naturaleza pero que resultan de la inoculación del agente patógeno por un insecto: garrapata, zancudo, tábano, mosca, etc., insecto que sirve de vehículo, de medio de trasmisión de un animal enfermo a otro sano.

Entre estas enfermedades, citaremos la fiebre de Texas o tristeza argentina, la meada de sangre de Chile o hemoglobinuria bovina, el mal de caderas, etc.

Cuando no se conozca el evertebrado que asegura la propagación del mal, se tratará de descubrirlo; pero si es conocido y no hay duda sobre su función y el peligro de su contacto con ciertos animales, se evitarán sus picaduras y se procederá a su destrucción por todos los medios conocidos.

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Tratándose de la fiebre de Texas, por ejemplo, impediremos que los vacunos tengan garrapatas sobre la piel o en el conducto auditivo, y las destruiremos con baños u otros medios si logran fijarse en algún punto del tegumento. Esta última medida se completará con la destrucción, en los potreros, de las plantas leñosas y los arbustos que les sirven de abrigo, etc. Por lamentable que sea, no sabemos todavía a qué insecto atribuir la inoculación del *Tripanosoma elmassiani* en la sangre del caballo afectado de mal de caderas, ni tampoco cómo penetra el hematozoario de la hemoglobinuria bovina, por lo cual deberemos recurrir a todos nuestros conocimientos y valernos de todos los medios para llegar a conocer el verdadero agente de cada una de estas infecciones. Es necesario, pues, observar mucho y experimentar en consecuencia.

Si no hemos señalado los tratamientos curativos aconsejados para combatir las enfermedades contagiosas, ha sido porque no conocemos ningún medicamento verdaderamente eficaz, ya sea para preservar el ganado de tales enfermedades o para impedir sus consecuencias fatales.

No seremos tan afirmativos con respecto a las enfermedades inoculadas por algunos evertebrados, puesto que sería negar el buen resultado obtenido con la quinina en el paludismo del hombre, con el atoxil en la enfermedad del sueño, etc. Pero nos parece que si llegamos a conocer ciertas medicinas que nos permitan combatir con éxito el mal de caderas o la hemoglobinuria bovina de Chile, por ejemplo, habremos dado un gran paso, que nos autorizará para esperar con más tranquilidad la preparación de una vacuna o de otro medio preventivo.

Terminaremos diciendo que las substancias medicinales que parezcan como las más apropiadas para la curación de las enfermedades infecciosas transmitidas por las picaduras de insectos, deberán ser objeto de una constante experimentación.

### CONCLUSIONES.

1°. Vacunación preventiva.
2°. Destrucción de los cadáveres.
3°. Supresión del consumo de las plantas punzantes.
4°. Uso exclusivo de aguas exentas de elementos patógenos.
5°. Desinfección de las pesebreras, establos, etc.
6°. Destrucción de los insectos que inoculan enfermedades virulentas con sus picaduras.
7°. Combatir las enfermedades inoculadas por picaduras de insectos (enfermedades debidas a protozoarios) con los medicamentos reconocidos como más eficaces.

### ENFERMEDADES PARASITARIAS.

Las enfermedades parasitarias graves, aquéllas que pueden causar la muerte de los animales domésticos o disminuir notablemente su valor, no son muy numerosas en Chile. Sólo citaremos la distomasis, algunas anemias verminosas, la cenurosis, la lepra, la triquinosis y la sarna.

Vale más preservar a los animales del parasitismo que combatirlo una vez implantado en sus cuerpos. Esto es algo que nos parece indiscutible en presencia de la dificultad, a veces de la imposibilidad, de desalojar los parásitos de ciertos órganos: cerebro o médula, hígado, etc.

La consideración anterior justifica, pues, a nuestro juicio, la preponderancia de los medios de preservación sobre los de curación.

1°. En los terrenos regados es muy difícil evitar la distomasis, porque los distomas encuentran en ese medio las más favorables condiciones para su propagación.

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Ya hemos expresado cuán peligrosas son las aguas detenidas, esos depósitos que se forman en los terrenos por falta de desagüe, cuando aparecen enfermedades virulentas, contagiosas; ahora, diremos que el peligro no es menor en caso de enfermedades parasitarias. En efecto, los huevos de los parásitos son arrastrados poco a poco hacia las pequeñas lagunitas, donde se acumulan y son tragados por los animales que beben tales aguas. Dichas lagunitas y las orillas de las acequias cubiertas de pasto, constituyen medios igualmente favorables para el desarrollo de ciertas especies. Los huevos y las larvas diseminados en el suelo se adhieren a la base de las plantas forrajeras cuando se efectúan los riegos, y en esta forma penetran en el estómago de los animales que las comen. Dadas las condiciones expuestas, la crianza de ovejas no puede mantenerse en los terrenos regados; y es así que vemos, por ejemplo, que la distomasis destruye la mayor parte de las majadas y que los terneros pagan a la enfermedad parasitaria un tributo enorme, tributo que hemos visto alcanzar durante el invierno hasta el 60 por ciento de los animalitos de la última parición.

La estrongilosis se propaga también en los terrenos húmedos.

En las lomas enjutas de la costa, por el contrario, las ovejas escapan al parasitismo.

En consecuencia, recomendaremos para las enfermedades parasitarias, como lo hicimos para las contagiosas, mantener el ganado en terrenos sanos, exentos de aguas detenidas, y el saneamiento de los terrenos demasiado húmedos, regados o no, a fin de evitar la anemia, la caquexia acuosa y las enormes pérdidas de animales que pueden ocasionar.

2°. Los excrementos de los perros portadores de tenias en sus intestinos, esparcidos en los potreros, son asimismo una causa de parasitismo grave en los herbívoros. La equinococosis y la cenurosis resultan de la introducción de huevos de las tenias equinococcus y cerebralis en el tubo digestivo de los vacunos y ovejunos, ya sea que los tomen directamente sobre el suelo, o en el establo al ser transportados con el pasto, cuando no los han tragado con las aguas detenidas y sucias que hemos mencionado.

En un fundo, será siempre prudente limitar la cantidad de perros a lo necesario para la conducción y la vigilancia del ganado, para la guardia de las casas y para impedir la introducción de perros forasteros. Además, todos los años se administrará (de preferencia dos veces en vez de una), con las precauciones del caso, un tenífugo de reconocida eficacia a los perros del dueño y a todos los del personal de la hacienda.

La cabeza y la columna vertebral de los animales sacrificados a consecuencia del torneo, como igualmente el hígado, los pulmones y riñones invadidos por los equinococos, se quemarán, con lo cual se impedirá el consumo de dichos órganos por los perros, consumo que los infectaría de tenias. La lucha contra las tenias de nuestros herbívoros consiste, pues, en vigilar a los perros, limitando su número y librándolos de las tenias que habitualmente abundan en sus intestinos.

3°. En cuanto a la lepra, basta que el puerco no tenga la posibilidad de comer los excrementos del hombre para que desaparezca por completo. No existe en las porquerizas bien establecidas, en que sus habitantes no salen hacia el exterior.

Los puercos que viven libres en la vecindad de las casas, no solamente comen excrementos sino también cadáveres de ratones y otros roedores, con lo que se infectan de triquina. La triquinosis es desconocida en los individuos que viven en porquerizas construídas con materiales resistentes y en que el aseo no falta. Un chiquero seco, con buena cama, evita el parasitismo tan frecuente y tan peligroso en los puercos que viven en el fango.

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4°. ¿Qué importancia debemos atribuir a los medicamentos que se usan para la destrucción de los parásitos en el organismo animal?

Los parásitos del estómago y de los intestinos de los monogástricos: caballos, puercos, perros, no resisten, en general a la acción de las substancias antihelmínticas y tenífugas, las cuales los entorpecen y provocan su evacuación con los excrementos. Hemos citado la expulsión de las tenias del perro; podemos agregar la de los œstros del caballo, etc.

Mucho más difícil es obtener el mismo resultado en los rumiantes, en razón de lo complicado de su estómago que dificulta la llegada del medicamento al punto en que se necesita.

Tratándose de parásitos alojados en las vísceras: hígado, pulmón, cerebro, médula espinal, y que causan la distomasis, la equinococosis o la cenurosis; o bien en el tejido conjuntivo, o en los músculos, dando origen a la lepra, la triquinosis, etc., consideramos que un tratamiento curativo, por bien establecido y aplicado que sea, de larga duración, y por consiguiente costoso y poco económico, no dará ningún resultado satisfactorio. Si es verdad que experimentalmente el Dr. Moussu y sus colegas han conseguido, en la distomasis, la expulsión del distoma hepáticum administrando el extracto etéreo de helecho macho, no lo es menos que esta substancia deja intacto al distoma lanceolatum, que acompaña siempre al primero.

En resumen, las medicaciones antiparasitarias prestan los mejores servicios cuando se trata de expulsar los parásitos del tubo digestivo; los parásitos de las vísceras y de varios tejidos escapan a su acción.

5°. De las enfermedades de la piel que resultan de su invasión por los parásitos animales, sólo citaremos la sarna, que causa grandes perjuicios cuando ataca a la mayor parte o a la totalidad de las ovejas de un rebaño. Insistiremos, pues, sobre la necesidad de combatirla con energía por los baños antisárnicos.

CONCLUSIONES.

1°. Uso de aguas exentas de huevos o de larvas de parásitos.
2°. Vigilancia de los perros pastores y otros del fundo.
3°. Buena edificación y aseo de las porquerizas.
4°. Uso de los antihelmínticos y tenífugos en casos determinados.
5°. Combatir la sarna con los baños antisárnicos.

## ARE UNIFORM REGULATIONS FEASIBLE AMONG THE DIFFERENT AMERICAN COUNTRIES FOR THE PREVENTION OF THE INTRODUCTION AND DISSEMINATION OF DISEASES OF ANIMALS?

By A. D. MELVIN,

*Chief of the Bureau of Animal Industry, United States Department of Agriculture.*

IMPORTANCE OF LIVE-STOCK SANITARY SERVICE.

The live-stock industry, always important, has become increasingly so in recent years. It is the source of a large part of our food supply, furnishes wool and hides for clothing, provides work animals, yields a number of incidental products, and contributes to the fertility of the soil. With the growth of population, and especially with the tendency of people to congregate in

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cities, the production and handling of meat and milk have become more complex and of increasing magnitude and importance.

The past 10 years have witnessed a growing shortage in the meat supply in many countries and in the world at large. This is especially true of beef. The increasing demand from countries which do not produce enough meat for their own people has brought about a large development of the meat-producing industry in other countries fitted by nature and favorable conditions to meet this demand.

These conditions have led to a great increase in commerce in live stock and animal products between the various countries of the world, as well as within the borders of each country. The more extensive movement of live animals greatly increases the danger of the spread of contagious animal diseases which may work disaster to the industry. A country that in former times was practically safe from outside plagues is now in danger of having them brought in with commerce, and diseases occurring to a small extent in limited areas of a country are liable to be spread throughout its territory.

The need for protection against these dangers has led to the formation of governmental agencies to safeguard the health of live stock and thus to conserve this valuable source of food and clothing. Live-stock sanitary police organizations are now to be found in most countries where the animal industry has been developed. The object of such organizations is threefold: (1) To protect domestic live stock from foreign contagion, (2) to prevent the spread of animal diseases within the country, and (3) to eradicate such diseases as may be present.

Live animals are moved from one country to another not only to be slaughtered for food or to be used for work purposes, but also as breeding stock. The latter class constitutes the greatest danger. If breeding animals are not free from disease they may defeat the very purpose for which they were imported, and infect and destroy the herds into which they are introduced instead of improving them.

In the case of imported meat, the consuming country wishes to have assurance that the products are wholesome and free from disease. An inspection of the finished product as it is imported is not sufficient to protect the health of the consumer. It is necessary that the producing country should conduct an inspection which is adequate to protect the consuming country.

### PAN AMERICAN COOPERATION DESIRABLE.

In matters of this kind the nations have become in a large degree dependent on each other. The nations of the Western Hemisphere are being drawn closer together by ties of common interest and growing commerce, and it is gratifying that they are showing a spirit of friendly cooperation. In order to minimize the difficulties of commerce and at the same time afford protection to all parties, there should be a mutual understanding and a common basis of action with regard to animal diseases. There can be no doubt of the advantages that would come from closer cooperation and the exchange of information. The questions for us to consider are the extent to which uniform regulations by the various American Governments are feasible, the form or principal features of the regulations, and the method or form of organization for carrying on a cooperative service.

The different conditions in the different countries would probably make an absolutely uniform set of regulations for all American countries impracticable. It should be possible, however, to have uniformity in certain fundamental features and to have cooperation in formulating and administering regulations and

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in exchanging information. A start in this direction has already been made by some of the South American countries which participated in a conference at Montevideo in 1912 at which a form of international agreement was drawn up and proposed for adoption by the various interested governments. The text of this convention is given by José León Suárez, of Argentina, as an appendix to his paper to be presented at this meeting. Such a plan, perhaps with some modification, might very well be extended to include all countries in the Western Hemisphere that are prepared to join in it.

### FUNDAMENTAL FEATURES.

Without undertaking at this time to formulate an exact plan, we may point out certain fundamentals that should and doubtless can be followed:

1. As a first step each country engaged in commerce in animals and animal products with other countries, or that wishes to engage in such commerce, should organize a competent veterinary sanitary service, if not already provided with such a service. This should include laboratories equipped for research work. No country that has not such a service, or that is receiving live stock indiscriminately from other countries, has any right to expect that its stock will be received by countries that are endeavoring to protect their own animals.

2. The veterinary service should make a thorough survey of the country so as to determine what contagious diseases of animals and what harmful animal parasites are present, and the regions where they exist. The collection of such information should be continued as a routine feature of the work, so that the service may be constantly informed of live-stock sanitary conditions throughout the country.

3. Laws and regulations, if not already in existence, should be carefully framed and adopted with the object of preventing the spread of contagious diseases within the country, preventing the introduction of infection from abroad, and preventing the transmission of infection to other countries. The principal measures required in the case of live animals for export should be inspection and certification assuring that they are free from contagious disease and that the locality from which they come is free from specified diseases. Imported animals should be inspected by the receiving country, and, under some circumstances, detained in quarantine for a time. In the case of over-seas importation the importer should be required to obtain in advance a permit from the Government of the country to which importation is desired.

4. If meat products are to be exported there should be laws, regulations, and an inspection system insuring their wholesomeness. Meat inspection is, of course, desirable also for the protection of the domestic population.

5. The foregoing features are already in effect to a greater or less extent in some of our countries, especially those where the stock-raising industry has been developed. A further step that seems very desirable is a system for the interchange among the various Governments of information regarding the presence or absence of animal diseases and parasites. In order that one country may feel safe in permitting importations from another, it must be in possession of reliable information as to sanitary conditions of live stock in the other country. Each country should know from what countries live stock is being received by other countries. One country could not be expected to receive animals from another when the latter was admitting stock from a country from which the first country is unwilling to permit importation. With an organization in each country constantly collecting full information as to conditions in that country, and then making this information available to other countries,

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either directly or through a central agency, each Government could more intelligently decide as to the safety of admitting live stock from other countries. With such accurate knowledge it would be possible to frame more liberal regulations and bring about greater freedom of commerce in live stock and animal products. Such a plan could also include the exchange of information as to methods of combating diseases. The form and details of such a system might very well be discussed and elaborated in this conference. A very simple form of organization should suffice. If a central agency seems desirable, perhaps the service could be performed by or through the Pan American Union.

In order to bring about greater uniformity in regulations it might be well to have a commission appointed consisting of representatives from various countries to formulate regulations that would be generally applicable and that might serve as a model for adoption between several Governments. Such a draft of regulations, in my judgment, should be as brief and simple as practicable and should deal with what are regarded as fundamentals or essentials, leaving details to be developed according to local conditions in the various countries.

## OUTLINE OF UNITED STATES REGULATIONS.

Excellent laws and regulations are already in force in some of the American countries. Without attempting to collate these various regulations it may be well to outline briefly the regulations with which I am most familiar, namely, those of the United States. These are not offered as a model for other countries or as being superior to those already adopted by other Governments, but merely to show the means that have been found feasible and effective in one country under the conditions existing there.

The regulations of the United States are based on national laws which provide, in brief, that live stock and meat food products may not be imported except under such regulations and inspection as may be prescribed by the Secretary of Agriculture, and that animals and meat food products may not be shipped from one State to another except under regulations similarly adopted. Provision is also made by law for inspecting live stock and animal products for export.

Under these laws four principal sets of regulations have been issued: (1) Those governing the importation of animals; (2) those governing the exportation of animals; (3) those governing the movement of animals among the various States of the country, and providing for the eradication of contagious diseases; (4) the meat-inspection regulations, which apply to meats for domestic use and for exportation as well as to imported meats.

1. The regulations governing the importation of animals apply to cattle, sheep, other ruminants, and swine. All such animals are subjected to careful veterinary inspection on importation, and in certain cases are also detained in quarantine for a period varying according to circumstances. Under some conditions certain certificates and affidavits as to the absence of contagious diseases in the region of origin are required. The tuberculin test is required in the case of all cattle six months old or over intended for dairy or breeding purposes.

2. The export regulations provide for inspection and certification whenever required by the country of destination. They also lay down certain specifications for the safe transportation of animals to be carried by ocean steamers. The latter requirement is both humane and commercial in its purpose.

3. The Department of Agriculture has a set of general regulations governing the interstate movement of live stock, and these are supplemented by separate

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specific regulations with regard to certain diseases such as Texas or tick fever, scabies of sheep, scabies of cattle, hog cholera, and tuberculosis. The object is, of course, to prevent the spread of disease from one part of the country to another by the movement of infected animals. In the case of parasitic diseases such as tick fever and scabies, dipping and inspection of animals from the infected regions are required, both with the object of eradication and as a condition to shipment. Cattle from the area quarantined on account of tick fever are allowed to be shipped in quarantine to certain market centers for immediate slaughter.

4. The Federal meat inspection applies to all establishments which slaughter animals or prepare meat food products for interstate or foreign commerce, but does not apply to establishments that do business entirely within a single State. When the inspection is conducted at an establishment, however, it covers the entire product even though only a portion may be intended for interstate or foreign commerce. This inspection covers about 60 per cent of all the meat produced in the United States. The regulations provide for an inspection of the live stock shortly before slaughter, for inspection at the time of slaughter, and for inspection and supervision throughout the various stages of dressing the meat and preparing the products. The inspections before and at the time of slaughter are made by qualified veterinarians, and the other inspections are made by them or by other experts. The regulations require that establishments shall be equipped and maintained in a sanitary condition. Adulterants and harmful preservatives and coloring matters, as well as false or misleading labels, are prohibited. The inspected product is stamped to show that it has been inspected and passed.

The importation of meats is allowed only from countries whose system of inspection is acceptable to the United States, and in addition the products are inspected on arrival at the ports of this country.

### PREVENTING AND ERADICATING DISEASES.

The subject assigned to me also includes the prevention and eradication of destructive diseases of animals. This work is highly important as a means of conserving the live-stock industry and the food supply of the people. The work of a veterinary sanitary service should not end with determining the presence or absence of contagious diseases and injurious parasites and preventing their introduction and spread. Where epizootics or parasites are present, their control and if possible their eradication should be undertaken and accomplished.

I am naturally most familiar with the work of this kind that has been done in the United States. In this country we have eradicated two diseases which have been introduced from abroad, namely, contagious pleuropneumonia and foot-and-mouth disease. The former was introduced and secured a foothold in the early eighties, and its eradication was an arduous task of several years. It has not since reappeared. Foot-and-mouth disease has gained entrance several times and each time has been promptly stamped out, usually before it had spread very extensively. The most serious of these outbreaks is one that appeared more than a year ago and the eradication of which appears to be just about completed at this time. The methods followed consisted of inspection to locate the disease, the slaughter and burial or cremating of diseased and exposed animals, and the disinfection of premises. Owners were reimbursed by payment of the appraised value of the animals and property destroyed, this expense being equally divided between the State and the Federal governments.

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Successful efforts have been and are being made to stamp out diseases which have long prevailed in this country. About 15 years ago systematic work was undertaken for the eradication of scabies of sheep and cattle, both of which diseases were widespread throughout the western part of the United States. Nearly all of this territory has now been freed, and it is hoped that the clearing of the remaining small area will be completed within a few years more.

The extermination of the ticks which spread so-called Texas fever of cattle was systematically begun in 1906. The infected district comprised most of the southern part of the United States and the southern half of California. After nine years of work in cooperation with State authorities more than one-third of this area has been freed of ticks and released from quarantine, and the work is well under way in other portions of the territory. This species of tick is also found in several other American countries, especially in the tropics.

Tuberculosis and hog cholera present difficult problems. The protective serum devised by scientists of the Bureau of Animal Industry affords a reliable means of preventing hog cholera, but the use of this serum in a way to stamp out the disease would be a very arduous undertaking. Some headway has been made in reducing tuberculosis by means of systematically applying the tuberculin test, especially to dairy herds, but no comprehensive plan of eradication has been undertaken. The use of the tuberculin test in dairy herds is mainly to protect the health of consumers of milk. This test has also been applied to breeding herds to some extent, and a plan has been formulated for cooperation between the Government and breeders of fine cattle with a view to freeing herds from this disease and registering free herds so that prospective purchasers may know where they can buy animals that are free from tubercular infection.

CONCLUSION.

In closing I suggest that this conference take some action toward communicating with the various American Governments in an effort to establish a system for the exchange of information, to bring about the adoption of uniform regulations so far as practicable, and perhaps to create a permanent Pan American organization of government veterinary officials for cooperation in live stock sanitary affairs.

Adjournment sine die of the subsection and of Section III.

68436—17—VOL III——61

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